EXHIBIT B

REDACTED VERSION OF DOCUMENT SOUGHT TO BE SEALED

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

ORACLE AMERICA, INC., Plaintiff, v. GOOGLE INC., Defendant.	))))))))))	Civ. A. No. 10-03561 WHA *(Jury)*

REPLY EXPERT REPORT OF PROFESSOR ADAM JAFFE, Ph.D.

FEBRUARY 29, 2016

CONFIDENTIAL – ATTORNEYS' EYES ONLY
PURSUANT TO PROTECTIVE ORDER

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on this 29th day of February, 2016, in Wellington, New Zealand.

Adam Jaffe, PhD

Table of Contents

I. ASSIGNMENT

1. I was retained by plaintiff Oracle America, Inc. ("Oracle") to undertake an analysis of whether Google Inc.'s ("Google") use of Oracle's copyrighted works constitutes a "fair use." On February 8, 2016, I submitted a report of my economic analysis of (1) the purpose and character of Google's use of Oracle's copyrighted works, (2) the effect of Google's use upon the potential market for or value of the Java platform, and (3) my analysis of certain economic assertions in Dr. Owen Astrachan's January 8, 2016 report.[1]

2. On February 8, 2016, Google's damages expert Dr. Gregory Leonard submitted a rebuttal report on damages.[2] I have been asked to respond to certain claims in Dr. Leonard's report which are fundamentally economic in nature. Many of Dr. Leonard's statements regarding economics also relate to aspects of the parties businesses which I described in my first report. I provide my analysis of Dr. Leonard's economic claims in this report.

3. The opinions and information contained in this report are based on my knowledge and understanding of the currently available record. However, my study is ongoing, and expert witnesses' depositions have not yet occurred. Accordingly, I reserve the right to revise and/or supplement my expert opinions to reflect any additional analyses I may formulate based upon additional testimony, newly acquired information, court determinations on evidence (e.g., if the court excludes or limits use of certain evidence for any particular purpose), or views expressed by the parties' expert witnesses. I also expect to create trial demonstratives including graphical depictions and presentations of my opinions.

4. A list of the materials I have relied upon in the course of preparing this report are in Appendix B.

II. QUALIFICATIONS

5. A full description of my qualifications is found in my February 8, 2016 report. I provide a brief summary here.

6. I am Director and Senior Fellow at Motu Economics and Public Policy Research in Wellington, New Zealand, and the Fred C. Hecht Professor in Economics Emeritus at Brandeis University in Waltham, Massachusetts. I have authored or co-authored over eighty scholarly articles and two books, have served on the editorial board of a number of economic journals, and am a Research Associate of the National

[1] See generally, Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.

[2] See generally, Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

Bureau of Economics. I have been qualified as an economic expert in several federal courts in the United States, and have consulted for owners and users of intellectual property on issues of valuation and interaction between intellectual property and competition.

7. My full curriculum vitae is attached to this report as Appendix A.

8. I am being compensated in this matter at my standard rate of $1,200 per hour. This compensation is not contingent in any way upon my testimony or upon the result of this proceeding.

III. SUMMARY OF OPINIONS

A. Scope of Report

9. In developing my opinions, I have read the expert report of Dr. Leonard and focused on certain claims within his report that are economic in nature. My response addresses only the economics of Dr. Leonard's assertions, and not his conclusions on damages. I understand that Oracle's damages expert Mr. James Malackowski may consider my economic opinions. I am not providing an overall analysis of damages in this report.

10. In his report, Dr. Leonard creates a series of alternative scenarios – sometimes referred to as counterfactuals – for the outcomes he believes would have happened if Google had not copied the 37 Java APIs ("Java APIs")[3], thereby appropriating the Java ecosystem of developers, OEMs and carriers.[4] These scenarios include the following alternative (but-for) worlds: (1) Google introduces Android without copying the Java APIs (for example, with a developer education program for a solution based on a different platform), or (2) Google does not introduce Android but instead remains a search provider on other parties' mobile phone platforms like Apple's. My analysis in this report largely focuses on these two sets of alternative scenarios – both of which substantially alter Google's actual technical and business behavior and decisions and require significant economic re-examination of Google's and Android's potential business outcomes.

11. Dr. Leonard offers one additional scenario in which Google licenses the Java APIs through Sun's OpenJDK license.[5] I discuss this option briefly in this report, but the base implausibility of this option is

[3] I understand "37 Java APIs" to refer to the declaring code and the structure, sequence and organization of the 37 Java API packages at issue.

[4] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[5] See generally, Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 85-87

already well-addressed in my February 8, 2016 report, and in the expert reports of other experts retained by Oracle.[6]

12. While there are some specific economic errors in Dr. Leonard's discrete scenarios, all of them suffer from neglecting to consider a common set of economic and business realities that must inform any consideration of plausible scenarios in which Google took a different path and either corrected for Google's copying of the Java APIs or did not introduce Android at all. In this report, I first describe the economic errors common across Dr. Leonard's analyses. I then provide economic analyses of specific errors that Dr. Leonard makes in certain discrete scenarios.

B. Summary of Opinions

13. In my first report, I wrote of the competitive consequence of Google's copying of the Java APIs.[7] Briefly, this copying happened at a particularly critical time for Google where a shift to mobile phone usage was becoming a serious threat to Google's future. During this time, a number of competitors emerged, and there was a high degree of uncertainty as to what position Google and its mobile application platform, Android, could achieve in the mobile market. Since then, Android has continued to be a critical element of Google's business success.

14. Dr. Leonard's analyses presume Google's eventual success with Android and fail to account for the fundamental uncertainty of that success and the critical role that the misappropriated Java application platform and its ecosystem of developers, OEMs and carriers played in that success.[8] This belies platform economics because in reality, most platform businesses fail. In contemplating a series of but-for scenarios, in which the Android platform is always successful, Dr. Leonard ignores one highly likely outcome - that if crucial competitive aspects (including Google's use of Java) of Google's Android strategy had been different, Android may never have gotten off the ground. Google's own internal correspondence, both at the time of launch[9] and after, reflects its perception that Java was necessary for Android.[10]

[6] See e.g., Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 189-193.

[7] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.

[8] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[9] Throughout this report I use "launch" in this context to refer to Google's public release of Android to market in 2008.

[10] See, e.g., TX 7 (Oct. 2005) & TX 10 (Aug. 2010).

15. Dr. Leonard's proposed counterfactual scenarios also fail to account for the dynamic nature of platform competition, particularly in the mobile application platform space, and are not instructive as to the measurement of economic harm. In other words, Dr. Leonard's counterfactuals suffer from the same flaw he warns against – they do not take into account the adjustments of the other economic actors in a highly volatile and dynamic ecosystem.[11] Specifically, Dr. Leonard's economic analysis does not take into account the nature of tipping points and lock-out in platform competition and instead takes as given that Android would have entered and captured the mobile market even if Google had not copied the Java APIs. In short, he assumes that a number of critical adjustments (e.g., Android enters the market later, Google does not use Java and gain the benefit of its attendant large developer base and ecosystem, or Android never exists as a platform at all) would have had little to no impact on Google's success with Android. This assumption is contrary to the available evidence and is unsupported by economic analysis.

16. In addition to presuming Android's own success, Dr. Leonard ignores the contemporaneous realities of the market in which Android was competing. Specifically, he does not acknowledge the possibility that if Android had not entered the market when it did, and the way it did, another player may have emerged in Android's stead. Dr. Leonard fails to consider that Microsoft, Apple, RIM, Nokia, and Sun were all vying for positions in the mobile platform arena. Attracting a critical mass of users on all sides of a multi-sided market is a prerequisite for success. Typically platform markets can only sustain a small number of competitors. Thus entering early and gaining substantial share before the market "tips" in favor of a competitor can make or break the success of a platform. For this failure alone, Dr. Leonard's analysis is incomplete and economically questionable.

17. Dr. Leonard also does not take into account expectations of platform participants such as OEMs, carriers, and developers. Users, in this case OEMs, carriers, and developers, are very often uncertain of new platforms, particularly when switching costs are high. Thus a platform's ability to attract a critical mass of participants in part depends on the expectations platform participants have about the future of the platform.

18. Finally, platform competition is extremely challenging to model and predict, particularly when market outcomes are highly uncertain, as they were for Android at its launch. Dr. Leonard ignores these challenges and instead attempts to apply a veneer of credibility to his analysis by referencing a number of economic papers and performing a regression analysis based on formulas that were developed for a different purpose. The papers on which Dr. Leonard relies are based on a world in which the mobile market has

[11] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 19.

already stabilized around Google and Apple as the number one and number two participants. Thus each paper is irrelevant to the question Dr. Leonard seeks to answer and is not instructive.

IV. CAUSAL NEXUS AND COUNTERFACTUALS

A. Dr. Leonard's Characterization of Causal Nexus and Counterfactuals

19. Dr. Leonard claims that Oracle's expert did not appropriately consider Google's alternative course of action absent the use of the Java APIs, or the adjustments other participants in the system would have made. [12]

> Speaking as an economist, the appropriate conceptual way to measure the causal effect of a factor on an outcome variable is to compare the difference in the outcome variable between the actual world and the counterfactual where the factor in question is altered exogenously from its actual value and the rest of the system is allowed to adjust. In the case of an economic system, this means that the economic actors are allowed to re-optimize and choose new actions in the counterfactual.[13]

Dr. Leonard further states:

> Finally, as noted above, [Oracle's damages expert's] analysis is incorrect because his counterfactual is incorrect: to determine how much (if any) value the allegedly infringing material contributed to Google's profits, in evaluating the counterfactual, Google must be allowed to respond optimally to the inability to use the allegedly infringing material, and the proper analysis must take account of the effect (if any) of Google's optimal responses on Google's revenues and profits.[14]

Dr. Leonard never fully describes Google's optimal response (or discusses the responses of other firms in the industry), but he does offer several alternative counterfactual scenarios, which I describe in brief above.

[12] From an economic perspective, whether or not it is necessary to consider alternative or counterfactual scenarios as a baseline depends on the purpose to which the analysis is to be put. I understand from counsel that the relevance of counterfactuals in a disgorgement analysis is a legal question. Therefore, Dr. Leonard's statement that there is an economic requirement to consider a specific counterfactual scenario as the baseline to measure disgorgement damages is unsupported. That being said and without regard for whether they are appropriate legally, I proceed to consider the validity of Dr. Leonard's counterfactual scenarios from an economic perspective.

[13] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 19.

[14] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 23.

B. Economic Omissions from Dr. Leonard's Counterfactual Scenarios

20. Constructing a reliable, non-speculative economic counterfactual is a challenging exercise, especially in the context of an early-stage, highly competitive platform market. Critically, counterfactuals should be constructed with a solid foundation of economic theory, and be consistent with well-known economic history, and should be informed by contemporaneous documents.

21. Dr. Leonard's counterfactual does not recognize the critical role that platform economics plays in the competition between the parties.[15] Specifically, in constructing his scenarios, Dr. Leonard fails to consider the impact of the following economic factors: (1) nonlinear market dynamics and their impact on the most likely but-for outcome; (2) expectations of ecosystem participants; and (3) the importance of early entry, tipping points, and network effects at the time of Google's copying. Each of these economic factors influenced the impact of Google's misappropriation of the Java APIs on Android's resulting market success. Dr. Leonard's omission of these key economic concepts renders the economic foundation of Dr. Leonard's counterfactual incomplete, speculative, and therefore unreliable.

1) Nonlinear Market Dynamics

22. Dr. Leonard's errors begin with his failure to recognize the essential business reality of platform markets: most fail. Failure is not only common, it is the most frequent and expected outcome.[16] Platform markets are complex[17] economic systems and changing any one assumption can alter the course of the outcome dramatically. The existence of network effects implies that the utility of a platform grows with the number of developers using it and quality of supported applications.[18] However, this relationship is highly non-linear: for example, a platform with a small community of developers (particularly relative to the community on other rival platforms), may not provide consumers appreciably more value than a platform with few or no developers.[19] This nonlinearity in platform utility implies that in a market with significant

[15] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[16] Evans, David S. and Richard Schmalensee, "Failure to Launch: Critical Mass in Platform Businesses," *Review of Network Economics*, 9.4 (2010).

[17] I use the word "complex" here not in the everyday usage sense of "complicated," but in the technical sense of complexity theory. In that theory, a system is "complex" if it has the property that small changes in conditions or actions can have disproportionately large impacts on the subsequent dynamic behavior of the system.

[18] Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3. M. Armstrong and R. Porter (eds.), North-Holland (2007) ("From a cooperative game theory perspective, network effects are just economies of scale: the per-buyer surplus available to a coalition of buyers and a seller increases with the size of the coalition.")

[19] See e.g., Marc Rysman, *The Economics of Two-Sided Markets*, 23(3) J. Econ. Perspectives 125 (2009).

network effects, a new entrant platform may need a large number of initial users in order to continue attracting additional users, obtain sustainable market share, and survive.[20]

23. Throughout history, technology firms have launched countless platforms that have not succeeded, typically failing to gain *any* critical mass of usage. Companies ranging from Digital Equipment (with its failed "Alpha chip" platform and the VAX 9000 mainframe during the 1980s)[21] to Microsoft (with a whole history of failures, including its Windows CE platform, or even its epic "Bob" operating system)[22], to Apple (with many failures, including the Apple Newton and the more recent Ping music platform)[23] have generated a sequence of platform failures.

24. In the mobile market, history is ripe with examples of previously successful companies failing in their attempts to enter the mobile market. For example, by 2000, Microsoft had already successfully built the Windows operating system for PCs and captured significant market share. Microsoft released its PocketPC mobile operating system in 2000, which was primarily used on Personal Digital Assistant (PDA) devices.[24] PocketPC eventually became Windows Mobile, and was later replaced by a more concerted launch into mobile with the Windows Phone in 2010.[25] None of Microsoft's efforts to gain share in the mobile OS or applications platform market was successful. In the third quarter of 2015, Windows Phone had attained only 1.3% share of worldwide smartphone sales.[26]

---

[20] See e.g., Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3, M. Armstrong and R. Porter (eds.), North-Holland (2007).

[21] Michael S. Malone, *DEC's Final Demise*, Forbes (Sept. 15, 2000), http://www.forbes.com/2001/01/19/0915malone.html.

[22] Daniel Eran Dilger, *The Spectacular Failure of WinCE and Windows Mobile*, Roughly Drafted (Jan. 27, 2007), http://www.roughlydrafted.com/RD/RDM.Tech.Q1.07/50755EA6-A759-42FD-84ED-EBB5A060AF16.html. Dan Fletcher, *Microsoft Bob*, Time (May 27, 2010), http://content.time.com/time/specials/packages/article/0,28804,1991915_1991909_1991855,00.html.

[23] Mat Honan, *Remembering the Apple Newton's Prophetic Failure and Lasting Impact*, Wired (Aug. 05, 2013), http://www.wired.com/2013/08/remembering-the-apple-newtons-prophetic-failure-and-lasting-ideals/. Nathan Ingraham, Ping, *Apple's failed music-focused social network, is officially closed as of today*, The Verge (Oct. 1, 2012), http://www.theverge.com/2012/10/1/3439168/ping-apple-music-social-network-closed.

[24] *Microsoft Releases Next-Generation PDA, the Pocket PC*, Microsoft (Apr. 19, 2000), http://news.microsoft.com/2000/04/19/microsoft-releases-next-generation-pda-the-pocket-pc/.

[25] Adam Z. Lein, Windows Mobile called, it wants all of its features back, PocketNow (Jan. 27, 2016), http://pocketnow.com/2016/01/27/windows-mobile-called-it-wants-all-of-its-features-back.

[26] *Gartner Says Emerging Markets Drove Worldwide Smartphone Sales to 15.5 Percent Growth in Third Quarter of 2015*, Gartner (Nov. 18, 2015), http://www.gartner.com/newsroom/id/3169417.

25. Microsoft's failure to achieve success with its mobile platform attempts, even though it was an established, well-known technology company that had previously built a successful PC operating system business, shows that expanding into a new platform market is difficult. Even a well-positioned entrant is not guaranteed success. This is because there are a number of platform characteristics that companies must get right, including pricing, timing, critical mass, and the specific market conditions in which they are competing must also align. Given all of these interconnected and dynamic economic factors, predicting success in platform markets with certainty is nearly impossible.

26. Google is no exception to the rule and has a record of several platform failures. For example, Google launched the Orkut social network within a week of the launch of Facebook, in early 2004.[27] But despite significant investment, the social network never gained significant share in the US, never tipped the market and was later discontinued.[28] Google also launched a free social networking site called Friend Connect in 2008, as an attempt to compete with the Facebook platform.[29] The platform never gained critical mass and was discontinued a few years later.[30] Google+ was launched in 2012, and despite massive promotion and very significant investment, never managed to threaten Facebook.[31] In each of these cases (as well as others) Google technologies failed to transition existing communities from an established platform to Google's own service.

27. While there are many reasons why platforms can fail, the most common is that they fail to reach critical mass in a timely fashion.[32] Platforms can create value by enabling communities of contributors like

[27] *Our History In Depth*, Google, https://www.google.com/about/company/history/ (Last accessed Feb. 23, 2016).

[28] Alistair Barr, *Google is Shutting Down Orkut, Its First Effort at Social Networking*, WSJ (Jun. 30, 2014), http://blogs.wsj.com/digits/2014/06/30/google-is-shutting-down-orkut-its-first-effort-at-social-networking/.

[29] Michael Arrington, *Three's Company Or Three's A Crowd? Google To Launch "Friend Connect" On Monday*, TechCrunch (May, 9, 2008), http://techcrunch.com/2008/05/09/threes-company-google-to-launch-friend-connect-on-monday/.

[30] *More spring cleaning out of season*, Google (Nov. 22, 2011), https://googleblog.blogspot.com/2011/11/more-spring-cleaning-out-of-season.html.

[31] Alistair Barr, *Google Gives Up on Google+ as a Facebook Rival*, WSJ (Jul. 27, 2015), http://blogs.wsj.com/digits/2015/07/27/google-gives-up-on-google-as-a-facebook-rival/ ("in late 2013 that Google+ had 300 million monthly active users, although exactly how active these people were was always questioned. At the time, Facebook had over one billion monthly actives and it has more than 1.4 billion now.").

[32] Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3. M. Armstrong and R. Porter (eds.), North-Holland (2007). See also, Evans, David S. and Richard Schmalensee, "Failure to Launch: Critical Mass in Platform Businesses," Review of Network Economics 9.4 (2010).

users, developers, content providers or advertisers to do things more effectively.[33] But there is little value in a platform to users if there are not enough developers to write applications; and there is also little value in a platform if there are not enough users to make it worthwhile for developers to write applications. Solving this classic "chicken-and-egg" problem is difficult, and the difficulty increases the later the platform is to market.[34] If a developer is already happy writing applications for one successful platform, why should he or she invest major amounts of money and time in developing applications for a platform that has no guarantee of success? For the late-to-market platform, it is an uphill battle. As explained in my initial report Android was already late.[35] And the more Android might have been delayed the smaller the probability of ever reaching critical mass.[36]

28. Thus overall, the most likely counterfactual for Android's prospects at launch would be to gain as much success as the Alpha chip, the Ping music platform, Microsoft Bob, or Google Friend Connect. Dr. Leonard, in addition to not considering the substantial likelihood of failure, incorrectly presumes the certainty of Android's success.[37]

29. It is inappropriate to simply assume away these risks and assume success, or even competitiveness. The eventual success of Android was not assured. Without having a development community already at (or beyond) critical mass, it is most likely that Google would have had a hard time maintaining its mobile market share, even with significant development investments and marketing expenditures. Another market participant could have established market dominance, in the same way that Facebook fended off Google's attempts to compete in the social network platform space. The most likely outcome of alternative scenarios would have been greatly reduced or zero long term market share for Android.

[33] See e.g., Marc Rysman, *The Economics of Two-Sided Markets*, 23(3) J. Econ. Perspectives 125 (2009).

[34] Zhu, Feng and Marco Iansiti, "Entry into Platform-Based Markets," *Strategic Management Journal*, 33.1 (2012).

[35] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.

[36] Zhu, Feng and Marco Iansiti, "Entry into Platform-Based Markets," *Strategic Management Journal*, 33.1 (2012); see generally Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.

[37] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

2) Expectations[38]

30. As I described in my February 8, 2016 report, one of the most important economic considerations in platform competition is the expectations of ecosystem participants.[39] The early stages of a platform market are typically characterized by a high degree of uncertainty.[40] The chicken-and-egg challenge described above is exacerbated by the expectations of the constituent groups, because expectations of platform success or failure typically influence participants' decisions to join the platform.[41] Thus, perceived likelihood of platform success will make users more confident that any requisite investment is worth their time, encouraging participation in the platform.[42] Conversely, any perceived weakness in a platform competitor will undermine expectations of its ultimate success and thereby limit its growth over and above the direct impact of the weakness on the competitor's attributes.

31. In this case, Google needed to attract users, developers, OEMs, and carriers to its mobile platform in order to launch Android. In his report's description of an alternative scenario in which Google still attempts to launch Android but does not copy the Java APIs, Dr. Leonard does not consider the expectations of any of the platform's key participant groups and how they would adjust. Most critically, Dr. Leonard ignores how the choice to use the Java APIs affected developer, carrier, and OEM expectations. At the time, Google had not built a mobile operating system or mobile application platform. Google was primarily a search advertising company without an installed base of third-party developers. In contrast, Sun had built a robust Java community of over 6 million developers, and had a strong presence in the mobile industry.[43] In hindsight, Google's eventual success with Android may seem like a foregone conclusion, but in 2005, Android's ability to attract and satisfy developers was highly uncertain. Selecting Java, an established application platform, as the basis for the Android platform signaled stronger likelihood of platform success to OEMs, carriers, and potential Android developers, thereby encouraging participation. Dr. Leonard's

[38] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 152. Dr. Leonard describes the economics of multi-sided markets. It is notable that he includes no discussion of expectations.

[39] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, pp. 16-17.

[40] Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3, M. Armstrong and R. Porter (eds.), North-Holland (2007). ("…competition between incompatible networks is initially unstable and sensitive to competitive offers and random event…")

[41] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, pg. 20. See also, Zhu, Feng, and Marco Iansiti. "Entry into platform-based markets." Strategic Management Journal 33.1 (2012).

[42] Zhu, Feng, and Marco Iansiti. "Entry into platform-based markets." Strategic Management Journal 33.1 (2012)

[43] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 100.

counterfactual analysis fails to account for how an alternative applications platform might have impacted the ability of Android to overcome uncertain expectations and is therefore unreliable.[44]

3) Order of Entry, Tipping Points, and Network Effects

32. Platform markets are subject to competitive forces that amplify the importance of market entry timing.[45] As I describe in my February 8, 2016 report, platform markets can often only sustain a small number of competitors because of network effects.[46] Once a given platform has reached a critical mass of users, markets can "tip" which makes entry and success of competing platforms difficult.[47] Google recognized this challenge and was therefore focused on developing a mobile platform presence to avoid getting "locked out."[48]

33. Dr. Leonard's counterfactual scenarios assume that the current mobile application platform competitive landscape—in which Android has achieved widespread success—would have been unchanged had Android entered after a delay of unspecified length.[49] This assumption ignores the critical need to enter a platform market early and establish sufficient scale to create network effects. Similarly, Dr. Leonard neglects to grapple with alternative scenarios in which Google's failure to copy the Java APIs (and the associated appropriation of the successful Java ecosystem of developers, OEMs, and carriers) led to Android's failure to realize the tipping benefits of network effects.[50]

34. Dr. Leonard fails to consider that had Google not launched Android when and in the manner it did, the mobile platform market might have tipped to another participant such as Apple, Microsoft or a new entrant. If Android attempted to enter the market later and without the support of Java application developers or an established applications programming interface, then consumers, hardware OEMs, carriers, and application developers would have been more likely to support rival platforms. Due to the existence and strength of network effects, such dynamics would be reinforced over time. Dr. Leonard's

[44] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[45] Zhu, Feng and Marco Iansiti, "Entry into Platform-Based Markets," *Strategic Management Journal*, 33.1 (2012).

[46] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 20.

[47] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 21.

[48] GOOGLE-22-00171914, at 923.

[49] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[50] Dr. Leonard also contemplates an alternative in which Google uses the Java APIs under the GPL v2-CE license. As I explain later in my report, OpenJDK was not an economically plausible option for Google.

omission of fundamental platform competition dynamics results in a counterfactual that does not provide a reliable prediction of what would have happened if Google had not copied the Java APIs.[51]

C. Market Participants and Potential Adjustments Not Considered

35. There are additional important market complexities that are ignored by Dr. Leonard's report. In constructing his alternative scenarios, Dr. Leonard ignores the potential reactions and adjustments by Google's competitors (key market participants with incentives to act in ways significantly adverse to Google). Perhaps most notably, Dr. Leonard does not adequately consider the possibility that another platform might have emerged in Android's stead if Google had not taken the Java APIs.[52] Accordingly, Dr. Leonard's unsupported construction of hypothetical outcomes in worlds in which Google does not copy the Java APIs is incomplete, highly speculative, and therefore unreliable.

1) Apple

36. As I describe in my February 8, 2016 report, the competition for mobile consumers between Apple and Google was substantially affected by Android.[53] In 2007, Apple released the first iPhone.[54] [redacted]. Yet, to avoid dependence on a third-party that it could not control, Google focused intently on building its own mobile application platform. Dr. Leonard's analysis does not acknowledge that a delayed Android, or an Android which did not come with an installed base of developers may have further increased Apple's head start over Android, potentially tipping the market.

37. Additionally, if a different mobile application platform not controlled by Google were to emerge as the primary competitor to Apple, Google's competitive balance with Apple would be seriously impaired. Dr. Leonard ignores this strategic and competitive value of Android in constructing his counterfactual, and instead assumes that Apple and other competitors would have not changed their behavior in a world without

[51] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[52] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[53] See e.g., Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 123.

[54] *Apple Reinvents the Phone with iPhone,* Apple (Jan. 9, 2007), http://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html.

Android.[55] Dr. Leonard does not consider the economic counterbalance Android provides to the risk of Apple terminating its agreement with Google, or increasing its demand of revenue sharing payment.

38. Using the Java APIs provided Google with not only faster time to entry, but also with the ability for Google to instantly leverage a large ecosystem of developers, OEMs, and carriers. This in turn allowed Google to increase its mobile share steadily, and eventually surpass Apple as the most widely used platform.

[redacted]

2) Microsoft Mobile

39. One of Google's primary competitors at the time of the development and launch of Android was Microsoft.[57] Microsoft was intent on developing a mobile application platform as well, and Google's own internal statements reflect the threat it perceived of Microsoft gaining significant mobile share and shutting Google out.[58] Although the Windows mobile platform never reached critical mass, when Android was released in the fourth quarter of 2008, Microsoft's mobile platform did have 12.4% share of the smartphone market.[59] Dr. Leonard assumes without economic support that Google's competitive dynamic with Microsoft in the mobile space would have remained the same even if Android had been launched under a significantly different set of circumstances. As I have explained above, this assumption is inconsistent with platform economics.

[55] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[56] Deposition of Jon Gold, Dec. 11, 2015, p. 226.

[57] Google SEC Form 10-K (2007), p. 19 ("Currently, we consider our primary competitors to be Microsoft Corporation and Yahoo! Inc. Microsoft has developed features that make web search a more integrated part of its Windows operating system and other desktop software products. We expect that Microsoft will increasingly use its financial and engineering resources to compete with us. Microsoft has more employees and cash resources than we do.")

[58] TX 8 (GOOGLE-01-00019529, at 9530) ("It is widely believed that if an open platform is not introduced in the next few years then Microsoft will own the programmable handset platform: Palm is dying, RIM is a one -trick-pony, and while Symbian is growing market share it's becoming a Nokia only solution.")

[59] *Gartner Says Worldwide Smartphone Sales Reached Its Lowest Growth Rate With 3.7 Per Cent Increase in Fourth Quarter of 2008*. Gartner (Mar. 11, 2009), http://www.gartner.com/newsroom/id/910112.

3) BlackBerry (RIM)

40. BlackBerry, formerly known as Research In Motion (RIM), was one of the earliest players in the smartphone market. In 2001, RIM launched a smartphone, whose mobile platform was based on Java.[60] By 2005, BlackBerry had gained initial popularity amongst professionals, as the phone had the capability for push email.[61] BlackBerry continued in popularity and prior to Android's uptake, in the fourth quarter of 2008, BlackBerry had about 20% share of the worldwide smartphone market.[62] Although Dr. Leonard, himself, states "economic actors are allowed to re-optimize and choose new actions in the counterfactual," he fails to take into account the potential of continued or enhanced success of players already in the market such as BlackBerry.[63]

4) Nokia

41. In December 2008, Nokia acquired Symbian, the software company that created the Java-based Symbian OS for smartphones.[64] By 2009, Symbian was the most popular smartphone OS worldwide, with 47% market share.[65] Additionally, following a similar strategy to Android, Nokia partnered with Sony Ericsson, Vodafone, Samsung, NTT DoCoMo, and AT&T, among others, to create the Symbian Foundation, a nonprofit organization with the plan of making the entire Symbian platform open source within two years.[66] Dr. Leonard fails to consider the potential impact on the smartphone market had there been continued success for Symbian in the absence or delay of Android, or the introduction of Android without the advantages of the Java APIs.

---

[60] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 55.

[61] Maggie Lake, *How BlackBerry conquered the world*, CNN (Mar. 23, 2005), http://www.cnn.com/2005/BUSINESS/03/23/blackberry rim/ ("People don't just use BlackBerry; once they've discovered it, they can't live without it.")

[62] *Gartner Says Worldwide Smartphone Sales Reached Its Lowest Growth Rate With 3.7 Per Cent Increase in Fourth Quarter of 2008*, Gartner (Mar. 11, 2009), http://www.gartner.com/newsroom/id/910112.

[63] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 19.

[64] *Nokia acquires Symbian Limited*, Nokia (Dec. 2, 2008), http://company nokia.com/en/news/press-releases/2008/12/02/nokia-acquires-symbian-limited. Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 62.

[65] *Gartner Says Worldwide Mobile Device Sales to End Users Reached 1.6 Billion Units in 2010; Smartphone Sales Grew 72 Percent in 2010*, Gartner (Feb. 9, 2011), http://www.gartner.com/newsroom/id/1543014.

[66] Chris Ziegler, *Nokia buys Symbian, turns software over to Symbian Foundation*, Engadget (June 24, 2008), http://www.engadget.com/2008/06/24/nokia-buys-symbian/ ("The move clearly seems to be a preemptive strike against Google's Open Handset Alliance, LiMo, and other collaborative efforts forming around the globe with the goal of standardizing smartphone operating systems; the writing was on the wall, and Symbian didn't want to miss the train".)

5) Sun

42. As I discuss in detail in my February 8, 2016 report, by the early 2000s, Sun had attained great success in the mobile market.[67] As of 2005, about 1 billion devices used Java ME.[68] By 2007, approximately 80% of mobile phones worldwide were based on the Java platform.[69] Further, in April 2007, Sun acquired the intellectual property assets of SavaJe, a mobile platform provider, to continue expanding its mobile efforts.[70] Sun used the SavaJe platform to build its own Java FX Mobile platform in mid-2007.[71] With Sun's track record of mobile success, continued efforts to evolve, and large developer base, Sun's Java was positioned for continued success in the mobile market. In addition to Sun's direct efforts to developing a mobile platform, Sun licensed Java in the market as well.[72] Dr. Leonard fails to take into account in his counterfactual analysis any potential success Sun/Oracle may have enjoyed, as a result of the delay or absence of Android, either directly from developing a smartphone OS or indirectly through licensing revenues.

6) Additional Entrants

43. In addition to ignoring potential changes in the behavior of the existing mobile competitors from 2005, when Google first decided to copy the Java APIs, Dr. Leonard fails to consider the impact of a delayed or impaired Android on other potential entrants.[73] If Android had not become the number-two, and then number-one mobile platform, its market position very likely would have been filled by another platform. As I describe in my first report, the entire technology industry was highly aware of the potential opportunity presented by mobile.[74] A number of other companies might have entered the market, or gained more share in the market. Further, a new entrant might have built a mobile application platform based on a licensed use of the Java APIs, adding even more uncertainty to the potential impact on the parties in this case. Dr. Leonard's scenarios are silent on the market adjustments of unnamed competitors in the mobile space, which makes his counterfactual analysis incomplete.

[67] See, e.g., Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 136-138.

[68] TX 134, p. 2 (GOOGLE-01-00018141).

[69] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 146.

[70] OAGOOGLE0000424812.

[71] OAGOOGLE0001049230.

[72] See, e.g., OAGOOGLE0100167800 (Symbian was a licensee of the Java platform).

[73] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

[74] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 50-53.

D. Google's Acknowledged Challenges Related to Platform Competition

44. Dr. Leonard's assumed market outcome is in direct contradiction to Google's contemporaneous perception as reflected in its statements and strategy documents. As I described in my first report, there is ample evidence that Google understood the nature of platform competition and was building Android with extreme urgency.[75] Google's actions are consistent with a company that perceived significant time pressure to not only finish technical development, but also to secure partnerships with carriers and OEMs, go-to-market, and begin building share. Google also had a clear view on the potential competitive benefits the Java APIs would provide in the dynamic mobile application platform market.

1) Early Entry and Building Scale

45. The following statements reflect the time pressure two key Android executives felt in 2005 and 2006.

> [Y]ou have a window of opportunity in smartphones . . . . You have to ship as soon as feasibly possible. I mean, you go to extraordinary lengths to ship sooner, because it's a very dynamic market. And it could shift directions at any time . . . . So my job . . . was to just do everything that I possibly could to get my solution to the market in the shortest time possible.[76] (Andy Rubin, Android founder, lead at Google)

> It is widely believed that if an open platform is not introduced in the next few years then Microsoft will own the programmable handset platform: Palm is dying, RIM is a one-trick-pony, and while Symbian is growing market share it's becoming a Nokia only solution.[77] (Rich Miner, Android engineer, to Andy Rubin)

46. As I described in my February 8, 2016 report, key Android executives had financial incentives to launch Android quickly. Google acquired Android Inc. in mid-2005.[78] The payouts to Android Inc. employees were contingent upon reaching certain time-bound achievements called "Milestones."[79] The

[75] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p.65-70.

[76] Deposition of Andy Rubin, Jul. 27,, 2011, 180:1-12.

[77] TX 8 (GOOGLE-01-00019529-532). See also, GOOGLE-67-00040897 ("Plan: Beat Microsoft and Symbian to volume by offering an Open Source handset solution").

[78] Google Buys Android for its Mobile Arsenal, Bloomberg Business, http://www.bloomberg.com/bw/stories/200508-16/google-buys-android-for-its-mobile-arsenal.

[79] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 97-98.

first Milestone required developing a working phone and securing a relationship with a major carrier within three years.[80]

47. Furthermore, even after the launch of Android, Google executives realized the importance of building share in the rapidly changing ecosystem and securing a place for Google. In 2010, Henrique de Castro, then-President of Mobile, reflected on the time sensitivity of building mobile share: "if we miss the 'mobile window', we'll be out of business in 10 years."[81]

2) Developer Expectations and Established Ecosystem

48. Google acknowledges the importance of jumpstarting its developer community and attracting that side of its platform market in order to develop critical mass. This factored into Google's decision to use the Java platform in building Android. Google realized it would mean a built-in base of millions of developers. For example, an early (2006) Android strategy document lists both (1) "Elegant [developer] tools story" and (2) "Existing pool of developers and applications" as key benefits of using Java.[82]

49. The benefits of using, and the need for Google to use, the Java platform for Android were discussed in many contemporaneous Google email exchanges. Several examples of these exchanges are listed below.

- "The point of the language, VM, and library effort is to provide a familiar and useful set of functionality to developers…"[83]
- "[Java] provides a familiar interface for developers, making it easier for a seasoned Java developer to write original code or port existing code."[84]
- "Having [Java] familiar functionality available to developers … is one less distraction from the bona fide benefits of what we are trying to do."[85]
- "Java is more accessible than C++. There are more Java programmers. There is more standardization in tools and libraries. Debugging is much simpler (especially for people who are not total rock stars—perhaps a lot of casual developers, etc)."[86]

[80] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 97-98.

[81] GOOGLE-23-00000049.

[82] TX 1, p. 8. (GOOGLE-00001779).

[83] GOOGLE-24-00017719.

[84] GOOGLE-38-00127518.

[85] GOOGLE-02-00359548.

[86] TX 13 (GOOGLE-01-00019511-513).

- "And, as with our rationale for including all the rest of the java packages, the reason for including this is because it is a platform-neutral (in terms of Android look and feel) set of classes which will make for a more familiar toolbox for developers."[87]

- "JavaOne is the largest developer conference of its kind and will bring together a very large number of developers who are very suitable for Android development. If there is any way we can hit them, it would be a good idea to try."[88]

- "writing great apps must be simple…
…we are building a java based system: that decision is final"[89]

- "With talks with Sun broken off where does that leave us regarding Java class libraries? Ours are half-ass at best. We need another half of an ass."[90]

50. Google also recognized the adaptability of Java for computing platforms. For example, on January 31, 2006, Sun's Vineet Gupta provided Google's Andy Rubin with a slide deck responding to Mr. Rubin's request for "[s]ome market presence numbers for Sun java," among other data.[91] The presentation highlighted Java's significant presence across an array of devices, as well as Java's global carrier relationships.[92] An example slide in Figure 1 below, shows the global carrier Java deployments.

[87] GOOGLE-24-00138208.

[88] GOOGLE-01-00035931-933.

[89] TX 23, p. 1 (GOOGLE-04-00055098).

[90] TX 215, (GOOGLE-01-00081881).

[91] TX 134.

[92] TX 134.

Figure 1: Global deployment of Java by carriers[93]

The presentation also described Java's popularity in gaming and other entertainment applications.[94] And, as seen in Figure 2 below, included Sun's "content marketplace" a pre-cursor to Apple's App store and Google's Play Store.

[93] TX 134, p.5.

[94] TX 134, p. 6

Figure 2: Java applications for gaming and entertainment[95]

51. These examples illustrate that Google well knew that using the Java APIs would provide significant advantages in a highly competitive, dynamic platform market. Additionally, even several years later, in 2010, after Android had entered the market, Google was investigating other technical alternatives, concluding that "they all suck" and "we need to negotiate a license for Java."[96] Google's own evaluations throughout time have indicated the value of the Java platform and ecosystem to Google. The fact that Dr. Leonard fails to consider the litany of contemporaneous evidence of Google's perceived ongoing need for Java platform and developers contradicts both the record and economic theory.

[95] TX 134, p.8.

[96] TX 10, (GOOGLE-12-10000022).

3) Dr. Leonard's Discounting of Google's Views

52. Dr. Leonard criticizes Oracle's experts for considering this highly relevant contemporaneous evidence: "Oracle's experts rely on contemporaneous Google documents discussing Google's perceptions of the market opportunity, but do not appear to have done any analysis to verify whether and to what extent Google's perception was accurate or that the window would have soon closed."[97] As an economist, I agree that there is always the potential that an economic actor's expectations are incorrect. However, given the contemporaneous evidence, Google's actual actions, and the lack of compelling economic bases to support an alternative scenario, it is most reasonable to assume that Google's expectations were in accordance with its decisions and subsequent actions. Indeed, at a minimum, Google acted in a manner consistent with its internal evaluations that entering quickly and beating competitors to scale was necessary. Moreover, Dr. Leonard did not provide any basis for why Google's perceptions were wrong at the time.

E. Consequences of Failure

53. I discuss above the several credible simultaneous platform competitors that Google faced at the time of Android's launch. In this section, I highlight several potential consequences of Android's failure to gain critical mass and become a successful mobile application platform. I explain these consequences of failure and benefits of Android to Google at great length in my February 8, 2016 report.[98]

1) Mobile Search Revenue Decline

54. As I also describe in my February 8, 2016 report, Google pays substantial premiums to provide search on Apple's iOS.[99] Those search traffic acquisition payments are affected by Google's competition with Bing for access to the preferred search position on the iOS.[100] In a non-Android alternative world, the competition that results in Google paying fees for carriage on iOS would be more intense – as access to the sole successful mobile platform would be even more valuable.

[97] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 165.

[98] See generally Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.

[99] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 123-26.

[100] Kristin Burnham, Apple Dumps Google Search For Microsoft's Bing, Information Week (Jun. 3, 2014), http://www.informationweek.com/software/operating-systems/apple-dumps-google-search-for-microsofts-bing/d/d-id/1269398 ("Apple has dealt Google another blow by announcing a new default Web search provider in its operating system: Bing").

55. Furthermore, if Microsoft had been able to capture more share in the mobile market, the impact on Google would have been more dramatic than Dr. Leonard contemplates. For example, by the time of Android's release in the market, Google and Microsoft's Bing search engine were competing for search share on the desktop. If Microsoft had become the next most popular mobile platform after Apple, it is unlikely that Google would have participated in any of the mobile search advertising revenue generated on the Microsoft mobile platform.

2) Loss of Ecosystem Control

56. If Google had failed to gain substantial share of the mobile platform market with Android, it would also have lost the opportunity to control important elements of the mobile ecosystem. As I discuss in my February 8, 2016 report, Google's control of the mobile ecosystem through Android provides many benefits, including data advantages, monetization opportunities like Google Play, and a boost to its advertising products.[101] Google understood the strategic value of control over a mobile platform. A May 2015 Google presentation states that the "Android ecosystem is central to Google's success."[102] Further, the same presentation shows not only the direct value of Android ([redacted] from Play and Hardware sales and [redacted] from advertising) but also the value in "driving activations and usage" across all Google products (e.g., YouTube, Chrome, Gmail).[103]

57. Dr. Leonard does not consider the economic impact of diminished or complete lack of mobile ecosystem control in a non-Android world. In Dr. Leonard's counterfactual, where Android does not exist, while Google may or may not retain the tenuous position of serving advertisements on other phones (iPhone), Google would lose a critical component of its business. The effects would be more extensive than just loss of revenue from mobile advertisements on Android (in-app and search), Google Play Store, and hardware sales but would include, and not be limited to, loss of reach, loss of users across Google products and services, and loss of data collected. Google publically recognized the importance of a mobile solution and the impact to its business, something that Dr. Leonard does not discuss.[104]

[101] Expert Report of Dr. Adam Jaffe, February 8, 2016.

[102] GOOG-00130338 at 339.

[103] GOOG-00130338 at 339.

[104] Google SEC Form 10-K (2004), at 58. ("If we are unable to attract and retain a substantial number of alternative device users to our web search services or if we are slow to develop products and technologies that are more compatible with non-PC communications devices, we will fail to capture a significant share of an increasingly important portion of the market for online services.").

F. Conclusion Relating to Dr. Leonard's Causal Nexus and Counterfactuals Opinion

58. Modeling the counterfactual world in the formative stages of a dynamic platform market is extremely challenging and can result in highly speculative results if one is not careful to fairly consider the important economic drivers of competition, as reflected in historical performance and in contemporaneous statements of the parties and observers. However, Dr. Leonard has not provided sufficient analysis to suggest his counterfactual scenarios are at all likely. He has omitted several key economic and market considerations, and ignores critical record evidence providing insight on the contemporaneous economic motivations of the parties.

V. WINDOW OF OPPORTUNITY

59. Dr. Leonard attempts to diminish the significance of Google's self-characterized "window of opportunity" by stating that Oracle's experts did not provide economic analysis demonstrating the window of opportunity existed, and did not describe when it began, ended, or its significance.[105] Dr. Leonard had not yet received my economic analysis of the competitive dynamics facing Google in the early days of Android.[106] Putting that aside, I discuss below why his statement about the window of opportunity is incorrect.

A. Economic Support of the Existence of "Windows" of Opportunity

60. As I describe above and in my first report, there are several economic factors that contribute to the dynamic nature of platform competition, including expectations, order of entry, network effects, and tipping points.[107] Collectively, these forces create a challenging environment for platform businesses that in fact causes most platform market entrants to fail, as described above.

61. The relevant economic question in this case is not the specific date on which the "window" opens or closes. The relevant analysis requires recognizing the impact of a set of dynamically changing economic forces on Google's likelihood of success in launching a brand new mobile platform. Google's "window" of opportunity to launch Android represents a time period in which competitive conditions aligned in a manner that allowed Google to *enter* the mobile market and begin its quest to build enough share to capture

[105] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 165.

[106] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 50-53, 65-70.

[107] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 20-23.

one of the limited platform provider positions sustainable in that platform market. Google itself used the term "window" in its assessment of the economic and competitive conditions it faced.[108]

1) Developer Expectations

62. In discussing the window of opportunity, Dr. Leonard fails to address the non-temporal effects of Google's use of the Java APIs on its ability to successfully enter and gain share.[109] In addition to providing a quicker path to entry, the Java APIs helped Google overcome the chicken-and-egg problem that platforms often face when launching. Google's use of the established Java platform as the basis for Android signaled a greater likelihood of success to developers, carriers, and OEMs, which helped solidify positive expectations and encouraged participation. Dr. Leonard's assumption that using a different technology platform would have at most resulted in a short delay is inconsistent with both the contemporaneous evidence and economic theory. Further, his assertion that the appropriate alternate reality is Google paying developers to learn a new platform ignores completely the role of expectations in determining success in network platform competition.[110]

2) Tipping Points

63. Dr. Leonard claims that the growth trajectory of Android suggests that a delay would not have affected Google's ability to enter and gain sufficient scale to avoid lock-out by another competitor. He does not explicitly describe the impact of a potential a delay in a market subject to network effects. While it is often difficult to predict exactly when a market will tip, once critical mass is achieved by one platform competitor, entry by another can become even more difficult.[111] This potential for markets to tip creates a time-bound set of conditions in which a potential participant such as Google can enter.

3) Challenges of Platform Markets

64. Throughout his report, Dr. Leonard ignores the delicate balance of circumstances that allow a platform such as Android to succeed. In reality, most platform businesses fail. I have discussed a number of platforms that failed above, particularly platforms that have failed in the mobile space, as well as

[108] Deposition of Andy Rubin, Jul. 27, 2011, 180:1-12.

[109] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 48-59.

[110] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 165.

[111] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 21. See also, Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3; M. Armstrong and R. Porter (eds.), North-Holland (2007).

Google's many failed platform initiatives. What Dr. Leonard does not acknowledge is that small changes in competitor actions, market conditions, and a number of both endogenous and exogenous factors can dramatically alter the outcomes in platform markets.

B. Google's Perspective on the Window of Opportunity

65. I describe in my first report[112] and in Section IV.D.1) above the numerous Google statements that indicate Google perceived a window of opportunity during which entering the mobile application platform market was feasible. In this report, I have also described the major challenges in predicting outcomes in a dynamic platform market. As such, Google's own predictions could have been wrong. However, the contemporaneous Google statements are the only lens we have on what was actually happening, and what participants with a vested interest in the outcome thought. Andy Rubin and the others who made statements about the time pressure and need to use Java in particular had a strong economic interest in the success of Android because of the structure of the Android Purchase Agreement.[113] I therefore give significant weight to the views of Google employees whose careers depended on making Android a success. Those employees viewed Java as an absolute necessity, and viewed Android's launch within the window of opportunity as an economic imperative. Similar to my criticism of Dr. Leonard's treatment of contemporaneous evidence in Section IV.D.3), as an outside expert, I would not opine that they were wrong without significant evidence and analysis that showed both how they were wrong, and why they so misperceived reality when they were in the middle of it.

C. Windows vs. Ramps

66. Dr. Leonard attempts to invoke evidence about the length of Android's path to 80%+ share as proof that the window of opportunity was wide.[114] This conclusion misses the point. Android's growth trajectory (once entered) is not the relevant consideration – starting on the path to scale in a timely and effective manner is what is important.

[112] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 65-78.

[113] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 71.

[114] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 165 ("In fact, to the extent there was any such window, it was reasonably wide in terms of time, as demonstrated by the fact that, even a year after the Android launch, the Android user base was still quite small."). Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 146 (80%+ Android share of mobile phone shipments).

67. Dr. Leonard also argues that a delay of 6-12 months would not have had an impact on Android's ability to gain share and compete, and instead would have just delayed the timing of Android's eventual success.[115] As I have described throughout this report, assuming that everything will evolve as before when changing major factors like early entry, and loss of a platform that affords a built-in base of 6 million developers is inconsistent with platform economics and yields speculative and unreliable results.

D. Conclusion Relating to the Window of Opportunity

68. As I describe above, from the perspective of market participants, economics, and Google executives there was an important window of opportunity influencing the potential for Android's success. First, the best evidence we have is Google's perception at the time, and Android founder Andy Rubin described this time period as a "window of opportunity."[116] Dr. Leonard ignores critical platform economic concepts in an attempt to obscure the fragile state of the market at the time. Furthermore, he has provided no evidence or analysis of how a delay may have impacted all the different economic factors that must be considered in an analysis of platform market formation.

VI. ECONOMIC PAPERS

69. Dr. Leonard references a number of economic papers in his report as support for his arguments about the counterfactual world. However, his application of the papers to his analysis is flawed for a common reason – they do not address the relevant time period and they are explicitly analyses of the world in which Java-based Android had already achieved significant market share. In this section, I describe further why the Bresnahan and Kim papers in particular are not appropriate for Dr. Leonard's analysis.

A. Inapplicability of Kim, Bresnahan Papers to Leonard's Analysis

70. The economic papers referenced by Dr. Leonard focus attention on the post-2010 time period. These papers include data from an Android product post-success, which is not the relevant economic inquiry in this case.

71. The appropriate question in this case and for the alternative scenarios Dr. Leonard attempts to address is whether or not the adoption of the Java APIs by Android upon its public release in 2008 enabled it to attract sufficient support from consumers, application developers, and hardware providers to get it to

[115] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 54.

[116] Deposition of Andy Rubin, Jul. 27, 2011, at pg. 180:1-12.

the point that it was competitive by 2010. The relevant time period of analysis should be the initial years of Android (not later years after it had already gained traction). Further, the papers Dr. Leonard chooses for support do not address the impact of belief and expectation formation, which, as described above, are critically important in platform competition.

72. When users (consumers, developers, etc.) form beliefs over the potential success of a platform, they are observing and using a variety of observable market indicators, which may include the current installed base of consumers and set of applications that are available, but also other factors that help predict the likelihood of *future* adoption by others.[117] These include factors that affect the relative cost and convenience for application developers to support and write for the platform, such as the adoption by Google of the Java platform. Further, uncertainty is the enemy of establishing platform success. Therefore, even if it were true that eventually non-Java Android would succeed in recruiting developers, people would not know that at the beginning. Seeing a nascent Android with an unknown and unproven library of APIs, they would worry that this might be a barrier to rapid development of apps. That worry might well make OEMs and other market participants reluctant to sign on with Android.

73. Thus, analyses that focus on the period after Android had garnered significant market share and application support ignore the importance to Android's success of providing the right environment for applications to be written. In essence, the Java platform increased the number of developers who could develop at low cost for Android, thereby increasing the likelihood that successful apps would be written, and thus also the expectations held by other developers and users that such successful apps would in fact be written (further increasing their support of the platform). Failing to account for this dynamic and focusing only on the period after Android had fulfilled users' positive expectations significantly understates Java's contributions.

B. Kim (2013): Essays on the Economics of the Smartphone and Application Industry

74. Dr. Leonard refers to two thesis papers by Min Jung Kim in his discussion. In this section, I describe the original intent of the Kim papers, how Dr. Leonard attempts to apply them, and the reasons why that application is flawed.

[117] Zhu, Feng, and Marco Iansiti. "Entry into platform-based markets." Strategic Management Journal 33.1 (2012). Michael Katz and Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 (3) The American Economic Review (1985).

1) Original Purpose and Summary of the Kim Analysis

75. Kim's unpublished thesis has two chapters. Dr. Leonard focuses on the second chapter of the analysis, which attempts to measure the contribution of applications to hardware/platform sales of iOS and Android in the 2010 to 2012 timeframe. Kim finds that applications are heterogeneous in terms of quality and user appeal, and that users on each platform have different preferences for application usage. Kim also finds that iPhone users have higher demand for applications than Android users, and Android sales mainly came from advantages in price-adjusted quality of hardware.[118] These findings are not, however, instructive to the exercise of determining outcomes in a non-Android world (or non-Java-based Android), or a world in which the entry dynamics of Android and likelihood of success are changed dramatically.

76. Before proceeding further, it is useful to discuss the methodology in Kim (2013). The Kim model is a "static" nested logit discrete choice model of demand for smartphones. This means that consumers do not anticipate the future when making decisions, nor consider past purchases when deciding what to buy in any period.[119]

77. More specifically, the first key assumption of Kim's model is that consumers in each month can decide to purchase one smartphone from those that are currently available, and "only consider the possibility of apps currently available."[120] This implies that consumers do not anticipate any changes to the set of products that are available (e.g., new phones), the possibility of new applications that will be released, or that prices may potentially fall (among many other things). Further, this also implies that a consumer only considers the utility that she will obtain in the first month of using a phone when deciding whether or not to pay the full purchase price. Additionally, this first key premise implies there are no restrictions on the number of phones that a consumer can purchase, and factors such as recently having purchased a phone or having certain experiences with given devices do not impact consumer's purchase decisions.[121]

78. When constructing a measure of the utility that consumers obtain from applications, Kim again assumes that consumers consider only applications that are currently available, and do not believe that any

[118] See generally, M.J. Kim, *Essays on the Economics of the Smartphone and Application Industry*, University of Minnesota (2013).

[119] See generally, M.J. Kim, *Essays on the Economics of the Smartphone and Application Industry*, University of Minnesota (2013).

[120] M.J. Kim, *Essays on the Economics of the Smartphone and Application Industry*, University of Minnesota (2013), p. 34.

[121] M.J. Kim, *Essays on the Economics of the Smartphone and Application Industry*, University of Minnesota (2013), p. 34.

additional applications will ever be released in the future. Further, Kim again assumes that consumers purchase applications only within the first month of smartphone ownership (and do not purchase any more applications in subsequent months). Kim's utility measure assumes consumers view applications as independent products, and do not treat any as substitutable (which implies that the 100th identical copy of a solitaire game is just as valuable as the 1st copy). Finally, the utility measure assumes that the actual sales of an application can be perfectly measured from observing its rank in an App Store top application list.

79. These sets of assumptions are questionable, and unlikely to be reasonable in the smartphone and application market. Nevertheless, Leonard uses Kim's estimates, which are derived from and therefor rely on these assumptions, in order to quantify what might have happened to Android sales had fewer applications been available on Android.

2) Kim's Estimates are Not Valid for this Analysis

80. There are several reasons why Kim's estimates are ill-suited for this analysis. First, her estimates rely on (imperfectly measured) data from a time period following the establishment of Android as a viable platform (February 2010 to December 2011), and not during the period of its launch, in which its success was uncertain. Kim, herself, noted that her model would be expected to change for estimating the time period before 2010.[122] Thus, even if her parameters were accurately estimated, they would not be appropriate for analyzing the period in question.

81. Second, the Kim model is a fundamentally static analysis of an inherently dynamic process. As is well known in the economics literature, estimating a static model of demand for a good that is inherently durable, such as a smartphone, will yield biased (i.e., incorrect) measures of consumer responsiveness to various product characteristics, including price and product attributes.[123] This concern is exacerbated in an inherently dynamic networked market such as the smartphone and application industry. As discussed in many peer-reviewed economic papers, failing to account for the fact that consumers are forward looking

[122] M.J. Kim, *Essays on the Economics of the Smartphone and Application Industry*, University of Minnesota (2013), p. 44 (Kim "expect[s] that the portion of the log-odds ratio explained by the app benefits was higher before 2010").

[123] Aguirregabiria, Victor and Aviv Nevo, "Recent Developments in Empirical IO: Dynamic Demand and Dynamic Games," Advances in Economics and Econometrics: Theory and Applications: Tenth World Congress, 2013.

and anticipate, among other things, the utility that they get from future use of a phone and from future applications that will be released will provide unrealistic and non-credible estimates.[124]

82. Finally, the key parameter from Kim that Leonard's analysis most directly relies upon is the value of σ, the coefficient on applications in Kim's model of smartphone demand. In other words, Kim's model seeks to provide an estimate of the degree to which smartphone sales are influenced by the availability of apps for those phones. The problem is that Kim's measure of smartphone availability is flawed for the reasons I describe above. It is well established in statistics and econometrics that when a variable is measured with error (e.g., flawed), a statistical estimate of the effect of that variable on other things will be subject to what is called "attenuation bias," which means that the model will tend to produce an estimate of the effect of the mis-measured variable that is smaller than the true effect. Because there is significant error in the measurement of application utility in Kim's model, it is highly like that attenuation bias is present in the estimated value of σ: i.e., the estimated value is incorrect and the true value is likely larger. This implies that relying on this estimate, as Leonard has done, will underestimate the impact of app availability on smartphone sales.

3) How Leonard Attempts to Apply Kim

83. In spite of these limitations, Dr. Leonard references Kim (2013) when arguing that "the differences in the available applications explained little of the relative changes in user shares between Android smartphones and iPhones, despite large changes in the number of available Android applications over the period."[125] He uses the Kim study and its (inconsistent) estimates to calculate what he claims to be "conservative" bounds to profit changes from a potential increase in Android application availability in a hypothetical counterfactual world.[126]

84. In order to apply Kim's model, Dr. Leonard makes further strong assumptions regarding the responses of app developers that directly influence the answers obtained from his analysis. The Kim model, as Dr. Leonard uses it, is highly reliant on assumptions about the set of applications that would exist in the counterfactual. Dr. Leonard assumes, without strong economic arguments, that nearly all important apps would be present:

[124] Gowrisankaran, Gautam and Marc Rysman, "Dynamics of Consumer Demand for New Durable Goods," *Journal of Political Economy*, 2012; Lee, Robin S., "Vertical Integration and Exclusivity in Platform and Two-Sided Markets," *American Economic Review*, 2013.

[125] Expert Report of Gregory K. Leonard, Feb. 8, 2016, paragraph 172.

[126] Expert Report of Gregory K. Leonard, Feb. 8, 2016, paragraphs 185-96.

> For each Android app, I determined whether (1) it is a Google app, (2) it was written using the NDK, (3) it was multi-homed on iOS, (4) its developer also developed apps for iOS, or (5) its developer also developed NDK Android apps. Any app in one or more than one of these categories is assumed to be available on Android in the counterfactual.[127]

85. Dr. Leonard's assumptions regarding the availability of apps in the but-for world ignores the importance of expectations. As I discuss above, the availability of future apps on a platform is related to users' expectations of a platform's success. In a similar vein, Dr. Leonard also fails to take into account how the expectations of other players in the ecosystem (e.g., carriers, OEMs, consumers) would also change if Google did not use Java. Dr. Leonard, instead, speculates that conditions would remain roughly the same in his counterfactual. Dr. Leonard's analysis thus ignores the responsiveness of future application availability to changes in current platform adoption or support (i.e., less software today means less hardware sales today which engenders less software available tomorrow, etc.). This understates the changes in Android's sales when there are fewer applications.

86. Since the damages estimates that Dr. Leonard produces are directly tied to the impact of the infringement on the Android app ecosystem, his assumptions have strong implications for the magnitudes of the damages. Within the structure of the Kim model, the more apps that are assumed to exist for Android in the but-for world and the less that other players in the ecosystem adversely respond to Android, the lower the damages are as a result of a lower Δ_A value (the effect of infringement on the attractiveness of the Android platform). In other words, Dr. Leonard aims to "estimate the decrease in Android handset sales that would have occurred in a counterfactual where there were fewer Android apps" by assuming that most of the apps would have been developed in the counterfactual regardless.[128] By assuming that many of the same apps (especially popular ones) are present in the counterfactual where the Java APIs are not used, Dr. Leonard mathematically ensures a low damages value without properly justifying these assumptions.

C. Bresnahan Papers

87. Dr. Leonard also refers to two different papers by economist Tim Bresnahan and his coauthors. In this section I briefly describe each paper, and explain why they are each inapplicable to Dr. Leonard's analysis.

[127] Expert Report of Gregory K. Leonard, Feb. 8, 2016, paragraph 192.

[128] Expert Report of Gregory K. Leonard, Feb. 8, 2016, paragraph 186.

1) Bresnahan Orsini Yin (2014): Platform Choice by Mobile App Developers

88. This paper examines the market-splitting outcome between Android and iOS in the US market by estimating both user demand for applications and the platform adoption decision of mobile app developers.[129] The authors find that user preferences do not vary much across platforms (e.g., for iOS vs. Android), but do for applications. Furthermore, user preferences for the same app do not vary much across platforms. The authors argue that these findings lead to an outcome in which developers of high-demand applications multi-home, and that market shares between iOS and Android devices are fairly stable.

89. The key take away from this paper is that due to the fixed costs of application provision, developers of high quality applications will tend to multi-home (create apps for both more than one operating system) despite modest shifts in installed bases of users. In turn, this means that consumers, who generally single-home (purchase one mobile phone at a time), will tend to make decisions between platforms that have sufficient number of applications on preferences of platform-specific differentiating factors, including apps that are available only on one platform.

90. However, the finding that the most popular apps multi-home once platform competition has settled into a fairly stable configuration does not mean that expected success with developers is unimportant in the initial competitive stage of evolution of the platform market. So the conclusions of this paper do not have any bearing on the extent or likelihood that a non-Java Android might have stumbled or failed.

2) Bresnahan Davis Yin (2015): Economic Value Creation in Mobile Applications

91. This paper is primarily a descriptive paper documenting various institutional details of mobile applications, and provides statistics such as the concentration of sales among applications, the churn among applications on the top download lists, and the prevalence of application developers investing in and marketing to users.[130] The most relevant part of the paper discusses incentives facing developers in choosing between iOS and Android. The authors' discussion mentions that "the installed base of iOS and Android phones is approximately equal".[131] This a balance that was only achieved well after the launch of Android. Today the user bases of iOS and Android are both large, and thus it is not uncommon for developers to create apps for both platforms. Importantly, the paper notes that although it is common for

[129] T. Bresnahan, et al., Platform Choice by Mobile App Developers, Stanford University (May 29, 2014).

[130] T. Bresnahan, J. Davis, and P.L. Yin, *Economic Value Creation in Mobile Applications*, The Changing Frontier: Rethinking Science and Innovation Policy (A. Jaffe and B. Jones, eds., 2015), Sections 5, 6, 7.

[131] T. Bresnahan, J. Davis, and P.L. Yin, *Economic Value Creation in Mobile Applications*, The Changing Frontier: Rethinking Science and Innovation Policy (A. Jaffe and B. Jones, eds., 2015), Section 9.

developers to *write* applications for both platforms is common, developers' spending money to *market* the application to audiences on multiple platforms is much less common.[132]

3) How Leonard Attempts to Apply Bresnahan

92. Dr. Leonard argues that because a small number of applications were present "in mobile platforms' early days…Java was not essential, or even important, for the provision of the 'killer apps' needed to get Android going".[133] This statement misses several key points.

93. First, the presence of killer apps that iOS already had (maps, browsing, etc.) were *necessary*, but by no means *sufficient*, for Android to "get going." In other words, apps that multi-home and are available on all systems are a requirement for a platform to be viable, but are not enough on their own to overcome the disadvantages that a new platform entrant faces. While high quality applications will tend to multi-home (and support both operating systems), once those applications are available consumers (who generally single-home and purchase a single phone) on a new platform, those consumers can then make decisions on preferences related to platform-specific differences.[134] These may include characteristics of the hardware, price, or—as is often the case—the availability of exclusive or single-homing applications.[135]

94. Thus, for Android to successfully compete against iOS, it needed first to get on the same footing by having certain key functions and applications (many of them developed by Google). Ultimately, however, Android relied on other forms of differentiation to attract users. Such forms of differentiation included hardware, pricing, and the availability of exclusive, Android-only software and applications.[136]

95. Dr. Leonard's analysis also fails to account for the heterogeneity in consumer preferences for different applications and products.[137] There are numerous economic papers that examine the long-tail of

[132] T. Bresnahan, J. Davis, and P.L. Yin, *Economic Value Creation in Mobile Applications*, The Changing Frontier: Rethinking Science and Innovation Policy (A. Jaffe and B. Jones, eds., 2015), p. 30.

[133] Expert Report of Gregory K. Leonard, Feb. 8, 2016, paragraph 127.

[134] T. Bresnahan, et al., Platform Choice by Mobile App Developers, Stanford University (May 29, 2014).

[135] For the application developers that did single-home and target a smaller potential market, it is likely that the costs of porting or supporting new application platforms was more costly than for more successful applications that were developed by larger firms. For many of these application developers, the ability to use a familiar application platform was more likely to have been a significant deciding factor. *See e.g.*, Lee, Robin S., "Vertical Integration and Exclusivity in Platform and Two-Sided Markets," *American Economic Review*, 2013.

[136] T. Bresnahan, J. Davis, and P.L. Yin, *Economic Value Creation in Mobile Applications*, The Changing Frontier: Rethinking Science and Innovation Policy (A. Jaffe and B. Jones, eds., 2015), Section 9.

[137] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.

retail products and note that although many products have low market shares in the aggregate, failing to account for the fact that consumers have very different preferences can drastically understate the utility derived by consumers of those products.[138] Similarly, even an application that is not downloaded by very many people can still deliver significant utility to those few. Dr. Leonard's analysis ignores the fact that the larger base of developers provided by the Java application platform increased the likelihood that these individuals with preferences would expect to find the applications that appealed to them on Android.

VII. ADDITIONAL ECONOMIC ERRORS IN DR. LEONARD'S ANALYSES

A. Plausibility of Google's adoption of OpenJDK

96. As a potential counterfactual, Dr. Leonard offers a scenario in which Google would have adopted OpenJDK. Dr. Leonard states, "Google's best alternative to using the allegedly infringing material was to use the OpenJDK or another programming language, not develop a set of APIs to replace the 37 APIs at issue."[139] I find this statement to be contrary to both economic rationale and the contemporaneous views of the parties involved.

97. Dr. Leonard estimates the cost to Google of implementing OpenJDK to be $85,000.[140] If Dr. Leonard's estimate is correct, it seems highly unlikely that Google would have moved forward in the unlicensed use of the APIs while risking litigation (which Dr. Leonard conservatively estimates to be $100 million)[141] and alienation of potential strategic partners ("making enemies").[142] As I discuss in my February 8, 2016 report, the fact that Google did not implement OpenJDK in 2007 as Android was being developed, or later, when Google faced litigation because of its use of the Java APIs, suggests that Google perceived significant costs or downsides to using OpenJDK.[143] Additionally, in as late as 2010, Google was exploring

[138] See e.g., Berry, Steven, and Joel Waldfogel. *Product Quality and Market Size*, The Journal of Industrial Economics 58.1 (2010): 1-31. Quan, Thomas, and Kevin Williams, *Product Variety, Across-Market Demand Heterogeneity, and the Value of Online Retail*, (2016).

[139] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 98.

[140] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 178.

[141] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, Footnote 61.

[142] TX 7 (GOOGLE-01-00019527, at 528). Andy Rubin states, "If Sun doesn't want to work with us, we have two options: 1) Abandon our work and adopt MSFT CLR VM and C# language – or 2) Do Java anyway and defend our decision, perhaps making enemies along the way."

[143] I understand that in the Oracle v. Google 2012 trial, a jury found that Google had copied the 37 APIs. Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, paragraph 441

technical alternatives in order to gain leverage in negotiating for Java.[144] This fact not only supports Google's perception of the importance of the Java ecosystem to Android, but also further sheds doubt on the plausibility of OpenJDK, which would seem to be a logical technical alternative.

98. Further, as I discuss earlier in this report, Dr. Leonard seems to disregard, without compelling economic support, the contemporaneous views of the economic agents with skin in the game. As an economist, I think about and weigh the decisions companies make when considering potential alternatives. As I discuss in my earlier report, there is significant evidence that important downstream players in the ecosystem (Carriers and OEMs) were not keen on GPL, and Google understood this position.[145] For example, Andy Rubin, states in May 2007:

> We do not believe phones can be built using GPL software. OEMs and carriers need the ability to differentiate, and therefore cannot be required to open source their proprietary features (GPL's "copyleft" requires this). This is the trick Sun and other such as Real Networks use to lure licenses into a direct license (aka dual license). It is fraught with problems, such as requiring any community contributions to also be dual licensed. That means community development is monetized by Sun![146]

99. Several months later, Andy Rubin again discusses his concerns of the open license for the various players in the ecosystem (Carriers, OEMs):

> The problem with GPL in embedded systems is that it's viral, and there is no way (for example) OEMs or Carriers to differentiate by adding proprietary works. We are building a platform where the entire purpose is to let people differentiate on top of it.[147]

100. I understand that these concerns from Google were grounded in real perceptions as key mobile partners were unlikely to use OpenJDK (GPLv2) because of the negative perceptions surrounding the virality of the open license.[148] Despite the legal issues surrounding the open license structure, from an economic standpoint, gaining success in a platform market is highly dependent on getting the players in the ecosystem on to your platform. Google understood and knew the importance of providing a solution that would attract OEMs and carriers to Android. Given the concerns expressed by Google during the time

[144] TX 10, (GOOGLE-12-10000022).

[145] Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, p. 190-192

[146] GOOGLE-26-00005730.

[147] GOOGLE-02-00020474. *See also*, TX 154 (Rubin states "GPL license (sun's license) doesn't work for us").

[148] Expert Report of Gwyn Murray, February 8, 2016.

period when Android was being developed, and the evident fact that it did not do so despite the costs and risks of relying on unlicensed Java, it is unlikely that Google would have chosen to implement OpenJDK as Dr. Leonard suggests. As I describe in my February 8, 2016 report, I understand that Google has not implemented the OpenJDK in any of the Android releases that are at issue in the case, including Marshmallow which was just released in late 2015.

B. OEM and Carrier Incentives

101. In his report, Dr. Leonard discusses several "reasons for the success of Android other than the alleged infringement."[149] As part of that discussion, Dr. Leonard cites the efforts of OEMs as a contributing factor in Android's success.[150] He describes that OEM adoption of Android led to the development of many different handsets, increased competition among OEMs, and eventually lowered prices for consumers. [151] Dr. Leonard's emphasis on the importance of OEMs does not acknowledge the influence that Google's copying of the Java APIs had in convincing OEMs and carriers to use Android in the first place (examples discussed further detail below).

102. Dr. Leonard states that Android was attractive to OEMs because it allowed OEMs to create differentiated software on top of Android, and Google did not charge OEMs to use the Android platform.[152] This assertion that differentiation was important to OEMs supports the implausibility of OpenJDK (discussed in detail above).[153] More importantly, Dr. Leonard's analysis of OEM incentives is incomplete because it presumes that Java had no role in garnering OEM support. Dr. Leonard's theory lacks economic foundation and is inconsistent with the facts of this case.

103. Dr. Leonard does not acknowledge the important role that the established Java platform, its large installed base of developers, or the wireless industry's existing use of Java played in securing OEM and carrier partnerships. Furthermore, Dr. Leonard does not describe how OEM decisions might be influenced

[149] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 34.

[150] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 42.

[151] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 42-45.

[152] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 42-45.

[153] As I explain in my February 8, 2016 report, I understand that the terms of the OpenJDK license impacted downstream users' ability to keep code proprietary, thereby limiting OEM and carrier opportunity to differentiate. (Expert Report of Dr. Adam Jaffe, Feb. 8, 2016, paragraph 443.)

by carrier technology requirements and vice versa.[154] Google itself acknowledged the benefits the use of Java would provide in securing ecosystem partner support. For example, in a presentation discussing the use of Java in Android, one slide noted, "Why Java?" carriers require it."[155] A 2005 email from Andy Rubin described the importance of Java to key wireless industry partners, "The nature of the cellular market is that we are *required* to have java due to carrier requirements, etc."[156] Additionally, OEMs raised questions to Google about the role of Java in Android, further cementing that the expectations of OEMs around using Android factored in the Java platform. For example, both Samsung and LG inquired about the role of Java in Android:

> How to test Java Runtime (Core Java Libraries & Dalvik Virtual Machine). Any test suite available?[157]
>
> Please confirm, the JAVA issue. What will be the Java license issue without SUN?[158]

104. Google delivered various presentations in its early efforts to secure partnerships with OEMs and carriers. Carriers and early OEM partners typically received a combined business and technology PowerPoint presentation.[159] These presentations highlight Android's use of the Java platform. For example, Figure 3 below, an excerpt from a presentation to LG in 2006, describes the Java Application Framework as one of the Android advantages.

[154] *See e.g.*, GOOGLE-01-00148180 ("LG is interested in the java compatibility so they can support Vodafone and Vodafone live requirements (JSRs)"

[155] GOOGLE-01-00017154. TX 7. TX 158.

[156] GOOGLE-01-00019511.

[157] GOOGLE-56-00018960, at -961 (Samsung questions for Google). Similar questions regarding Android's implementation of the Java Core Libraries were surfaced by T-Mobile, ASUSTek, and HTC. *See e.g.*, GOOGLE-56-00017401; GOOGLE-56-00017329; GOOGLE-22-00072075.

[158] PX 185, at p. 7 (LG questions for Google). *See e.g.*, GOOGLE-29-00002088, p. 4; GOOGLE-56-00018960, p. 2; GOOGLE-56-00018960, p. 4; GOOGLE-24000152227, p. 3; GOOGLE-24-00152227, p. 25; GOOGLE-24-00013099, p. 7; GOOGLE-03-00146539, p. 3; GOOGLE-03-00146539, p. 19; GOOGLE-01-00066237; GOOGLE-01-00066262; GOOGLE-03-00139402; GOOGLE-03-00146539, GOOGLE-03-00147537; GOOGLE-03-00067085; GOOGLE-03-00067085; GOOGLE-22-00124385; GOOGLE-22-00122689; GOOGLE-22-00072076; GOOGLE-22-00051824; GOOGLE-22-00073880; GOOGLE-56-00017330.

[159] *See e.g.*, GOOGLE-24-00010460, at -508 (Sprint Nextel April 2007); GOOGLE-24-00152227, at -229 (LG 2006).

Figure 3: Android Presentation to LG (2006)[160]

105. Versions of this "Android Advantages" slide containing the "Powerful, simple Java Application Framework" language were included in several presentations in the 2006 to 2008 timeframe, to both OEMs and carriers.[161]

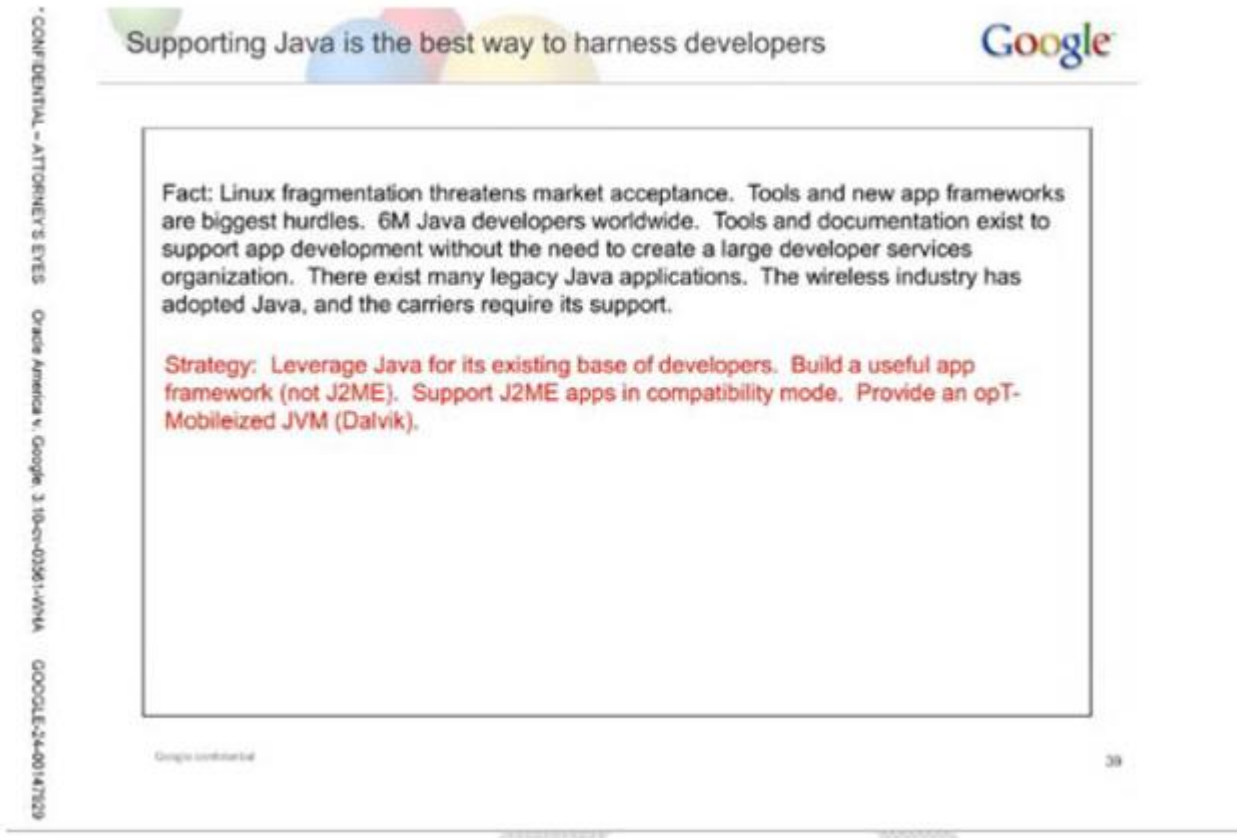
106. Google similarly referenced the benefits of Java and its ecosystem to mobile carriers. For example, in a 2006 meeting with T-Mobile, Google described supporting Java as the "best way to harness developers."[162] Figure 4 below, shows this description:

[160] GOOGLE-24-00152227, at -229.

[161] *See, e.g.*, GOOGLE-24-00010460, at -508 (Sprint Nextel April 2007); GOOGLE-24-00019558, at -583 (Vodafone Jan 2007); GOOGLE-24-00152227, at -229 (LG 2006); GOOGLE-59-00014897, at -942 (Cingular 2006); GOOGLE-24-00206924, -970 (Sprint 2006); GOOGLE-03-00146539, at -541 (Qualcomm 2007); GOOGLE-24-00015101, at -126 (Telefonica 2007); GOOGLE-24-00015413, at -438 (Orange 2007).

[162] GOOGLE-24-00147891, slide 39; The same presentation referenced application level Java interface to telephony sub-system, standard Java class libraries, Java developer tools, and Java application framework. GOOGLE-24-00147891, slides 40, 56, 59, 60, 71, 73 and 77. The same slide appeared in a 2006 presentation to Chinamobile. TX 0158 (GOOGLE-01-00025575).

Figure 4: Google presentation to T-Mobile (2006)



Similarly, in 2007, Google describes the benefits of Android to Japanese mobile operator DoCoMo as including a "blazingly fast Java implementation".[163]

107. Google's emphasis of Java in its pitches to OEMs and carriers, and the Android team's statements characterizing OEMs as essential to gaining OEM and carrier support indicate that the Java APIs were, in fact, highly important in early OEM and carrier adoption of Android.[164] Furthermore, OEMs' desire for Java is consistent with the nature of platform economics, particularly with respect to the importance of expectations. OEMs, as economic agents, act based on the information they have and the expectations they form based on that information. In 2008, the OEMs with which Android sought to partner were already using the Java platform in mobile devices. For example, both the Java Technology for the Wireless Industry (JTWI) and the Symbian Foundation were backed by many prominent OEMs and carriers:

[163] GOOGLE-29-00002088, p. 4.

[164] Appendix C provides a list of Google references to Java in the context of Android potential partner presentations.

> The initiative [JTWI] has received widespread support from leading representatives of the mobile industry, including Orange, Siemens, Sony Ericsson, Sun Microsystems and T-Mobile International. It is expected that a number of these companies will join Nokia and Vodafone to become members of the Expert Group for the specifications created by this initiative.[165]
>
> Nokia, Sony Ericsson, Motorola and NTT DOCOMO announced today their intent to unite Symbian OS™, S60, UIQ and MOAP(S) to create one open mobile software platform. Together with AT&T, LG Electronics, Samsung Electronics, STMicroelectronics, Texas Instruments and Vodafone[166]

The Java APIs had stabilized and were a proven solution in the wireless industry. The Java developer community had over 6 million members. As an economist, I find it highly unlikely that Google's choice to use the Java APIs in Android did not influence OEM and carrier decisions to select Android in any way. Yet Dr. Leonard's discussion is silent on the impact of these factors.

108. In sum, Dr. Leonard's failure to disentangle the effects of Google's copying of the Java APIs when discussing incentives for OEMs and carriers to use Android and the resulting impact on Android's success. For this reason, his discussion of OEM and carrier efforts on the impact of Android adoption is circular and uninstructive.

C. Developer Training

109. Dr. Leonard's theory of developer training fails to account for several economic factors that would significantly negatively impact the cost and even the plausibility of such a program.

110. Dr. Leonard posits that one "contribution of the alleged infringement was to allow Google to save on training or development costs".[167] In this analysis, Dr. Leonard claims that Google could have paid for the training of developers had they used another programming application platform. Dr. Leonard limits his calculation to a subset of already successful developers (developers with an application in the Top 100 Daily List, 2012-2015) and a single $715 C++ course.[168] This theory is unreliable as it underestimates or

[165] *Nokia and Vodafone to lead roadmap for mobile Java standards*, Vodafone (26 Sep 2004), http://www.vodafone.com/content/index/media/vodafone-group-releases/2004/press_release26_08 html.

[166] *Mobile leaders to unify the Symbian software platform and set the future of mobile*, NTT DoCoMo (Jun. 24, 2008), freehttps://www.nttdocomo.co.jp/english/info/media_center/pr/2008/001408 html.

[167] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, p. 68.

[168] Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, Exhibit 3c.

fails to adequately address the breadth of developer retraining that would actually be necessary, if such retraining was possible at all. Dr. Leonard's retraining theory suffers from a series of errors that I describe below.

111. Dr. Leonard claims that only a small set of already successful developers would need to be trained.[169] This suffers the same problem encountered throughout his report, Dr. Leonard relies on ex-post analysis, where it would have actually been highly uncertain which and how many developers would need to be trained and which apps would ultimately be successful. In reality, a much greater superset of developers would need to be trained on Google's platform, those developers would then need to compete, only then would the top developers be evident, and further those developers could change over time. Thus, the appropriate starting point for any such training program would actually be the entire superset of developers that could potentially develop top apps.

112. It would be exceedingly difficult for Google to reach a new superset of developers without leveraging the community aspects of the Java ecosystem. Economically, Google would face substantial identification and other transaction costs to reach the appropriate set of developers. These consist of identifying the individual developers to train, contacting them, and persuading them to enroll. These considerations would greatly increase the cost for developer training as compared to Dr. Leonard's incomplete analysis of just the cost of a standard course.

113. As I discuss above, expectations are critical in achieving platform success. Even if Google was able to identify the set of developers, convincing those developers to engage in such a training program would require Google to convince them of Android's success. I describe the difficulty of achieving such expectations absent Java above.

114. Developers, as rational economic agents, seek to maximize their profit. Developers who take time to learn a new language are forgoing profits that could be made during that time. Additionally, developers would need to believe that learning a new language would be beneficial in the long run. In terms of expectations, developers who have had success and familiarity previously programming on a well-established language like Java need to be convinced to expend time and effort to pick up another platform. These opportunity costs alone would be larger than the mere cost of a standard course.

[169] Dr. Leonard determines 1,972 developers needing to be trained, but states that as of 2011 there were 20,000 Android developers. Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016, paragraph 102, Exhibit 3c.

115. Finally, the notion that developers receiving training in the alternative language would put that hypothetical alternative Android on equal footing with Android based on unlicensed Java ignores the crucial role of cumulative experience in application development. An app developer with significant experience designing Java-based apps who then takes a course in C++ is not then an experienced C++ app developer. The gap in their experience working in C++ compared to Java would make writing apps for the hypothetical C++-based Android more difficult, more costly and less effective than their writing apps for a Java-based system, and that difference would persist until significant experience with the new system accumulated. Thus, overall, Dr. Leonard's calculation of the costs associated with developer training is so far from including all of the relevant costs as to be economically meaningless.

VIII. CONCLUSION

116. Dr. Leonard's damages analysis purports to measure the economic impact of Google's copying of the Java API packages. However, Dr. Leonard fails to address critical economic and competitive dynamics that were present at the time of Google's copying. His analysis does not take into consideration key platform economic factors such as nonlinear market dynamics, platform business failure rate, order of entry, windows of opportunity, and tipping points, as well as ecosystem participant expectations. Further, Dr. Leonard relies on third-party economic models that are simply not applicable to facts of this case. Most fundamentally, Dr. Leonard proposes a series of counterfactual scenarios, all of which presume Google's ultimate success with Android, when in fact Android's success was highly uncertain especially when one removes the critical component of Google's appropriation of the Java ecosystem including its 6 million developers and mobile OEMs and carriers. As a result, Dr. Leonard's damages analysis is speculative and unreliable.

PROOF OF SERVICE BY KITEWORKS

I, José E. Valdés, am over the age of eighteen years old and not a party to the within-entitled action. My place of employment and business address is Orrick, Herrington & Sutcliffe LLP, 1000 Marsh Road, Menlo Park, California 94025.

On February 29, 2016, I served the following documents:

REPLY EXPERT REPORT OF ADAM JAFFE, Ph.D.

on the interested parties in this action by electronic service [Fed. Rule Civ. Proc. 5(b)] by electronically mailing a true and correct copy, pursuant to the parties agreement, to the following email addresses:

DALVIK-KVN@kvn.com
JCooper@fbm.com
gglas@fbm.com

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed on February 29, 2016, at San Francisco, California.

/s/ José E. Valdés
José E. Valdés

APPENDIX A

ADAM B. JAFFE

PROFESSIONAL EXPERIENCE

Motu Economic and Public Policy Research, Wellington, New Zealand

Director, May 2013 ongoing

Te Pūnaha Matatini Centre of Research Excellence

Economics and Social Science Research Theme Leader, 2014 ongoing

Queensland University of Technology
Adjunct Professor, 2015 ongoing

Auckland University Business School
Sir Douglas Myers Visiting Professor, 2014

Brandeis University, Faculty of Arts and Sciences and International Business School, Waltham, MA

Fred C. Hecht Professor in Economics Emeritus, 2014 onward
Research Professor, 2014 onward
Fred C. Hecht Professor in Economics, 1999 - 2014
Dean of Arts and Sciences, July 2003 to June 2011
Chair, Department of Economics, 2000 - 2002
Associate Professor of Economics, 1994 - 1999
Chair, Brandeis Intellectual Property Policy Committee, 2001 - 2003
Member, University Advisory Council, 2001 - 2011

National Bureau of Economic Research

Faculty Research Fellow (1985-1994) and then Research Associate (1995 onward)
Co-founder and Co-organizer, Science and Technology Policy Research Workshop (1995-98) and Innovation Policy and the Economy Group (1999-2007)
Project Coordinator, NBER Research Project on Industrial Technology and Productivity, 1994-1999 (funded by the Alfred P. Sloan Foundation)

Organization for Economic Cooperation and Development (OECD), Paris

2002-2003 *Visitor*, Directorate for Science, Technology and Industry

Economics Resource Group, Inc.

1988-1999 Founding partner

Harvard University, Faculty of Arts and Sciences, Cambridge, MA

Associate Professor of Economics, 1989 - 1994
Assistant Professor of Economics, 1985 - 1989
visiting the Kennedy School of Government, 1992-94

President's Council of Economic Advisers, Washington, DC
Senior Staff Economist, 1990 - 1991

EDUCATION

Harvard University, Cambridge, MA
Ph.D. in Economics, 1985
Dissertation: "Quantifying the Effects of Technological Opportunity and Research Spillovers in Industrial Innovation"

Massachusetts Institute of Technology, Cambridge, MA
S.M. in Technology and Policy, 1978
Thesis: "Regulating Chemicals: Product and Process Technology as a Determinant of the Compliance Response"
S.B. in Chemistry, 1976

TESTIMONY AND CONSULTING EXPERIENCE

Television Music License Committee, Radio Music License Committee, Viacom, Inc. and Netflix, Inc (Weil, Gotshal & Manges, New York)
Prepared written comments and attended consultation at the U.S. Department of Justice *Antitrust Consent Decree Review –ASCAP and BMI 2014*

Television Music License Committee (Weil, Gotshal & Manges, New York)
UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK, MEREDITH CORPORATION, THE E.W. SCRIPPS COMPANY, SCRIPPS MEDIA, INC., HOAK MEDIA, LLC, HOAK MEDIA OF NEBRASKA LLC, and HOAK MEDIA OF DAKOTA, LLC, v SESAC LLC and JOHN DOES 1–50, 09 Civ. 9177 (PAE); Written Expert Report (March 2013); Deposition (April 2013)

Television Music License Committee (Weil, Gotshal & Manges, New York)
United States District Court, Southern District of New York, WPIX, Inc., *et al*, against Broadcast Music, Inc., 09 Civ. 10366 (LSS), Expert Report, December 23, 2011; Rebuttal Report January 30, 2012; Deposition March 6, 2012

Enbridge Southern Lights pipeline (Steptoe and Johnson, Washington DC)
U.S. Federal Energy Regulatory Commission Docket Nos. IS11-146-000, IS10-399-000, IS10-399-001,IS10-399-003 (Consolidated), Prepared Rebuttal Testimony, November 1, 2011; Oral Testimony January 10, 2012

Enbridge Southern Lights pipeline (MacLeod Dixon, Calgary)
National Energy Board of Canada, Hearing Order RH-1-2011, Written Reply Evidence, October 6, 2011; Oral Testimony November 17, 2011

Teva Pharmaceuticals USA, Inc. (Goodwin, Proctor, Boston)
United States District Court, Southern District of New York, Teva Pharmaceuticals, et al, v Mylan Pharmaceuticals, et a 09 CV 8824, Expert Report, December 2010, Deposition January 2011

DMX, Inc. (Weil, Gotshal & Manges, New York)
United States District Court, Southern District of New York, United States v. American Society of Composers, Authors, and Publishers (In re Application of THP Capstar Acquisition Corp.), 09 Civ. 7069 (DLC), Expert Report, July 2010; Rebuttal Expert Report, August 2010; Deposition, August 31, 2010; Trial Testimony November 2010.

DMX, Inc. (Weil, Gotshal & Manges, New York)
United States District Court, Southern District of New York, Broadcast Music, Inc. against DMX, Inc., 08 Civ. 216 (LLS), Interim Phase Declaration, August 2008; Interim Phase Deposition, September 2008; Interim Phase Reply Declaration, October 2008, Declaration, August 14, 2009, Deposition, September 14, 2009; Trial Testimony January 2010.

Teva Pharmaceuticals USA, Inc. (Brinks Hofer Gilson & Lione, Chicago)
United States District Court, Southern District of New Jersey, Merck, Sharpe and Dohme Pharmaceuticals SRL v. Teva Pharmaceuticals USA, Inc., expert Report, September 2008; Deposition December 2008, trial testimony February 2009.

Ariba, Inc. (Heller, Ehrman, San Francisco)
In the United States District Court for the District of Massachusetts, Sky Technologies, LLC v. Ariba, Inc., Written Expert Report, July 27, 2007

Finance Ministry, Government of Chile (Santiago, Chile)
Consultation on the development of innovation policy for Chile (2007)

Pro Se Testimony

Before the US House of Representatives, Committee on the Judiciary, Subcommittee on Courts, the Internet and Intellectual Property. Oversight Hearing on the Patent System, "American Innovation at Risk: The Case for Patent Reform." February 15, 2007.

A Group of Internet Webcasters and Radio Broadcasters (Weil, Gotshal & Manges, New York)
Before the Copyright Royalty Board, Library of Congress, Washington, DC; in the Matter of: Digital Performance Right in Sound Recordings and Ephemeral Recordings. Docket No. 2005-1 CRB DTRA. Testimony October 31, 2005; Oral Testimony June 26, 2006; Rebuttal Testimony on Behalf of Internet Webcasters and Radio Broadcasters September 29, 2006; Rebuttal Testimony on behalf of National Public Radio September 29, 2006; Oral Rebuttal Testimony, November 8, 2006.The World Bank (Washington, DC)

The World Bank (Washington, DC)
Consultant regarding project evaluation methodologies for project on financial support for commercial innovation in El Salvadore

Television Music License Committee (Weil, Gotshal & Manges, New York)
Before the American Arbitration Association, SESAC, Inc. against Television Music License Committee. Expert Report, December 2, 2005; Oral Testimony, January 25, 2006

Television Music License Committee (Weil, Gotshal & Manges, New York)
In the United States District Court, Southern District of New York, United States of America against American Society of Composers, Authors, and Publishers, In the Matter of the Application of Post-Newsweek Stations, Inc., et al., Applicants, For the Determination of Reasonable License Fees, 41 Civ. 1395 (WCC) (MHD). Expert Report March 17, 2004; Deposition May 14, 2004; Rebuttal Expert Report June 18, 2004; Deposition July 22, 2004.

Pharmaceutical Care Management Association (Steptoe & Johnson, Washington, DC)
In the United States District Court for the District of Maine, Pharmaceutical Care Management Association v. G. Steven Rowe, in his official capacity of Attorney General of the State of Maine. Declaration, September 2, 2003.

Castano Tobacco Litigation Plaintiff's Legal Committee (Murray Law Firm, New Orleans)
In the Civil District Court for the Parish of Orleans, State of Louisiana, Gloria Scott and Deania M. Jackson, et al., vs. The American Tobacco Company, Inc., et al. Expert Report, June 6, 2000; Deposition, October 18, 2000; Oral Trial Testimony, January 30, February 4-5, 2003.

Television Music License Committee (Weil, Gotshal & Manges, New York)
Before the American Arbitration Association, SESAC, Inc., against Television Music License Committee. Economic analysis of a reasonable license fee for public performance of SESAC music. Expert Report, January 11, 2002.

Phillips Transportation Alaska, Inc. (Birch, Horton, Bittner and Cherot, Anchorage)
State of Alaska, The Regulatory Commission of Alaska, In the Matter of the Application of BP Pipelines (Alaska), Inc. and Phillips Transportation Alaska, Inc., for the Transfer of 3.0845%

Interest in the TAPS System. Affidavit (with Lisa J. Cameron) evaluating the competitive impact of a proposed sale of capacity on the Trans Alaska Pipeline System from BP Pipelines (Alaska), Inc., to Phillips Transportation Alaska, Inc., May 25, 2001; Supplemental Affidavit (with Lisa J. Cameron), July 10, 2001.

SFPP, L.P. (Vinson & Elkins, Houston)

United States of America before the Federal Energy Regulatory Commission, In the Matter of ARCO Products Company, et al., v. SFPP, L.P. Prepared Answering Testimony evaluating whether there has been a substantial change in the economic circumstances that were the basis for interstate rates, May 15, 2001; Reply Testimony, July 31, 2001; Oral Testimony, October 25-26, 2001; Supplemental Testimony, February 20, 2002.

A group of internet broadcasters (Weil, Gotshal & Manges, New York; Wiley, Rein & Fielding, Washington, DC)

Before the United States Copyright Office, Library of Congress, in the Matter of Digital Performance Right in Sound Recordings and Ephemeral Recordings. Direct Testimony in an arbitration proceeding involving the valuation of the right of public performance of digital sound recordings and ephemeral recordings, April 11, 2001; Oral Testimony, August 27-28, 2001; Written Rebuttal Testimony, October 4, 2001; Oral Rebuttal Testimony, October 19-20, 2001.

The Burlington Northern and Santa Fe Railway Company (Steptoe & Johnson, Washington, DC)

Before the American Arbitration Association, Tucson Electric Power Company, Claimant, v. Burlington Northern and Santa Fe Railway Company, Respondent. Direct testimony in an arbitration proceeding concerning a coal transportation contract, January 26, 2001; Deposition, February 9, 2001.

Cheminova A/S (Beveridge & Diamond, Washington, DC)

Before the American Arbitration Association, In The Matter of Arbitration Between Cheminova A/S, Claimant and Griffin LLC, Respondent, Docket No. 23 171 00020 99. Direct Oral Testimony in a data compensation case concerning a pesticide, December 7, 2000; Oral Rebuttal Testimony, December 9, 2000.

Music Choice (Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, Washington, DC)

In the United States District Court, Southern District of New York, United States of America against Broadcast Music, Inc., et ano., In the Matter of the Application of Music Choice, et al., Applicants, for the Determination of Reasonable License Fees. Affidavit, July 28, 2000; Expert Report, January 26, 2001; Supplemental Expert Report, March 9, 2001; Deposition, March 28, 2001; Affidavit, April 9, 2001; Oral Testimony, May 29, 2001.

Wilson-Cook Medical Incorporated (Brinks Hofer Gilson & Lione, Chicago)

In the United States District Court for the District of Massachusetts, Boston Scientific Corporation and SCIMED Life Systems, Inc., v. Wilson-Cook Medical Incorporated. Expert Report analyzing irreparable harm related to preliminary injunction in a patent infringement

case, July 26, 2000; Deposition, July 27, 2000; Supplemental Expert Report, September 15, 2000.

Owens-Corning (Forman, Perry, Watkins, Krutz & Tardy, Jackson, MS)

In the Circuit Court of Jefferson County, Mississippi, Ezell Thomas, et al. (as to all defendants) and Owens-Corning (as to tobacco defendants only) versus R.J. Reynolds Tobacco Company, et al., and Amchem Products, Inc., et al. Expert Report prepared on behalf of Owens Corning in tobacco litigation, June 14, 2000; Deposition, September 13, 2000.

Ellis Simon, *et al.* (Brown, Rudnick, Freed & Gesmer, Boston)

In the United States District Court, Eastern District of New York, Ellis Simon, et al., v. Philip Morris Incorporated, et al., CV-99-1988, First Amended Class Action Complaint. Testimony on behalf of the plaintiffs in tobacco litigation; Expert Disclosure Statement, December 20, 1999; Deposition, February 28, 2000; Affidavit, April 13, 2000.

Vastar Resources, Inc.

Before the United States of America, Department of the Interior, Minerals Management Service, Further Supplementary Proposed Rule for Establishing Oil Value for Royalty Due on Federal Leases, Affidavit, January 31, 2000. *Before the United States of America, Department of the Interior, Minerals Management Service, Vastar Resources, Inc.'s Request for a Binding Value Determination on Transportation Allowances,* Affidavit April 4, 2000. Testimony on behalf of Vastar Resources, Inc., on issues related to the appropriateness and reasonableness of various methodologies that may be employed for the purpose of determining transportation allowances to be used for royalty payments from federal leases.

Pharmaceutical Research and Manufacturers of America

Prepared research report entitled "Consequences of Pharmaceutical Price Controls on Innovation" (with Catherine Moore), May 1999.

PacifiCorp (Stoel Rives, Portland, OR)

Before the Public Utility Commission of Oregon, UE 102, In the Matter of the Application of Portland General Electric Company for Approval of the Customer Choice Plan. Testimony on behalf of PacifiCorp regarding the company's eligibility to participate in an auction of generation assets, April 26, 1999.

Turner Broadcasting System, Inc., et al. (Weil, Gotshal & Manges, New York)

In the United States District Court, Southern District of New York, United States of America against American Society of Composers, Authors, and Publishers, In the Matter of the Application of Turner Broadcasting System, Inc., et al., Applicants, For the Determination of Reasonable License Fees, CIV. NO. 13-95 (WCC), Expert Report prepared on behalf of the applicants in litigation about music licensing fees, April 16, 1999; Deposition, July 26-27, 1999; Rebuttal Expert Report, December 16, 1999; Deposition, March 3, 2000.

The American Chemical Society

Developed and evaluated a number of approaches to pricing the web editions of ACS's publications. Modeled the performance of the various pricing plans to assess their ability to protect ACS's publications revenue as web editions replace paper. (1999)

Copyright Clearance Center, Inc. (Weil, Gotshal & Manges, New York, NY)

Primary consultant on statistical and economic matters since 1985. (ongoing)

Procter & Gamble, Inc. (Torys, Toronto)

In the Matter Between Unilever PLC. and Lever Brothers Limited, Plaintiffs, and Procter & Gamble, Inc., and the Procter & Gamble Company, Defendants, Court File No. T-2534-85, Expert Report prepared on behalf of the defendants in patent dispute, January 11, 1999; Reply Report, January 29, 1999; Oral Testimony, December 6-7, 1999.

Ironworkers Local Union No. 17 Insurance Fund and its Trustees (Milberg, Weiss, Bershad, Hynes & Lerach, San Diego)

Ironworkers Local Union No. 17 Insurance Fund and its Trustees, et al., vs. Philip Morris, Inc., et al. (Ohio), Expert Report prepared on behalf of the plaintiffs in tobacco litigation, November 6, 1998; Supplemental Report, December 17, 1998; Deposition, January 11 and 21, 1999; Oral Testimony, February 23, 1999.

State of Wisconsin (Habush, Habush, Davis & Rottier, Milwaukee)

The State of Wisconsin v. Philip Morris, et al. Prepared Expert Witness Report on behalf of the plaintiffs in tobacco litigation, November 1, 1998.

Trans-Alaska Pipeline (Steptoe & Johnson, Washington, DC)

In the Matter of the Correct Calculation and Use of Acceptable Input Data to Calculate the 1997, 1998, 1999, 2000 and 2001 Tariff Rates for the Intrastate Transportation of Petroleum over the Trans Alaska Pipeline System Filed by Amerada Hess Pipeline Corporation; Arco Transportation Alaska, Inc.; BP Pipelines (Alaska) Inc.; Exxon Pipeline Company; Mobil Alaska Pipeline Company; Phillips Alaska Pipeline Corporation; Unocal Pipeline Company; Phillips Transportation Alaska, Inc.; and Williams Alaska Pipeline Company, LLC, and the Protest by Tesoro Alaska Petroleum Company of the 1997 and 1999 Tariff Rates, *Before the Regulatory Commission of Alaska, Docket No. P-97-4.* Prepared Direct Testimony evaluating whether the TAPS Intrastate Settlement and the ratemaking methodology it established produce tariff rates that are just and reasonable, October 8, 1998; Second Prepared Direct Testimony, July 12, 2000; Prepared Rebuttal Testimony, February 26, 2001; Oral Testimony, April 10-13, 2001.

Commonwealth of Massachusetts (Brown, Rudnick, Freed & Gesmer, Boston)

The Commonwealth of Massachusetts vs. Philip Morris Incorporated, et al., Civil Action Number 95-7378. Prepared Expert Disclosure Report on behalf of the plaintiffs in tobacco litigation, June 16, 1998; Affidavit in Opposition to Defendants' Motions for Summary Judgement, October 30, 1998.

CBS (Weil, Gotshal & Manges, New York)

CBS Inc. v. American Society of Composers, Authors & Publishers, New York State Supreme Court, New York County. Prepared Expert Report regarding timing of payments under ASCAP agreements, August 11, 1997; Deposition, June 12, 1998; Addendum to Prepared Expert Report, December 1, 1998; Supplemental Deposition, January 28, 1999.

Public Broadcasting System, National Public Radio, and the Corporation for Public Broadcasting (Weil, Gotshal & Manges, New York)

Prepared testimony regarding royalties for copyrighted musical compositions, *In the Matter of the Rates for Noncommercial Educational Broadcasting Compulsory License*, *Before the Copyright Arbitration Royalty Panels*, *Docket No. 96-6, CARP NCBRA,* 1997. Written Testimony, April 1, 1998; Oral Testimony, April 1-2, 1998; Rebuttal Testimony, April 15, 1998; Oral Rebuttal Testimony, May 7, 1998.

State of Minnesota (Robins, Kaplan, Miller & Ciresi, Minneapolis)

The State of Minnesota and Blue Cross and Blue Shield of Minnesota vs. Philip Morris Incorporated, et al., Court File No. C1-94-8565. Prepared Expert Witness Report on behalf of the plaintiffs in antitrust litigation involving allegations of collusive conspiracy, May 29, 1997; Deposition, June 26-27, 1997; Oral Trial Testimony, March 18-23, 1998.

PacifiCorp (Stoel Rives, Portland, OR)

PacifiCorp, Electric Restructuring Transition Plan, Before the Montana Public Service Commission, Docket No. D97.7.91. Prepared Prefiled Rebuttal Testimony evaluating testimony regarding market power in the generation of electricity in Montana, February 24, 1998; Prefiled Surrebuttal Testimony, July 21, 1998.

PacifiCorp (Stoel Rives, Salt Lake City)

United States District Court for the District of Idaho, *Snake River Valley Electric Association v. PacifiCorp*, *Case No. CV 96-0308-E-BLW.* Testimony analyzing allegations of anticompetitive behavior and evaluating market power. Expert Witness Statement, October 17, 1997; Affidavit, February 27, 1998; Expert Report, January 22, 2002; Supplement to the Expert Report, April 8, 2002; Revised Supplement to the Expert Report, August 15, 2002; Affidavit, September 18, 2002; Oral Testimony, September 20, 2002, October 15, 2002.

Trans-Alaska Pipeline (Steptoe & Johnson, Washington, DC)

Prepared Affidavit and Rebuttal Affidavit evaluating the competitive impact of the Amended and Restated Capacity Settlement Agreement, *Exxon Pipeline Co., et al.*, *Application of TAPS Carriers for Approval of Amended and Restated Capacity Settlement Agreement*, *Before the Federal Energy Regulatory Commission*, *Docket No. OR96-1-000, et al.* (1997)

The Burlington Northern and Santa Fe Railway Company (Steptoe & Johnson, Washington, DC)
Prepared Verified Statement regarding market power in transporting coal, *In the Matter of Western Fuels Service Corporation v. The Burlington Northern and Santa Fe Railway Company*, *Before the Surface Transportation Board*, *STB Docket No. 41987*. (1997)

PacifiCorp (Stoel Rives, Portland, OR)
Assisted in FTC pre-merger Hart-Scott-Rodino review; prepared *Economic Analysis of Alleged Vertical Market Power Consequences of Merger of PacifiCorp and Peabody Coal*. (1997)

Subaru of New England, Inc. (Todd & Weld, Boston)
Subaru of New England, Inc., vs. Subaru of Wakefield, Inc., Civil Action No. 96-01475-A, Commonwealth of Massachusetts, Norfolk County, Superior Court Department. Prepared Affidavit regarding appropriate methodology for assessing competitive impact of dealer relocation, November 20, 1996.

Public Service Company of New Hampshire
Direct testimony before the State of New Hampshire Public Utilities Commission, Docket No. DR 96-150, Electric Industry Restructuring, with Joseph P. Kalt, October 18, 1996.

Pro Se Testimony
United States of America before the Federal Energy Regulatory Commission "Alternatives to Traditional Cost-of-Service Ratemaking for Natural Gas Pipelines, Regulation of Negotiated Transportation Services of Natural Gas Pipelines," Docket No. RM-96-7-000. Comments of Adam B. Jaffe and Joseph P. Kalt, May 30, 1996.

Massachusetts Technology Collaborative
Prepared a study assessing the effects of reductions in federally funded R&D on the Massachusetts economy. (1995-96)

Federal Trade Commission
Asked by Commission staff to prepare testimony for Hart-Scott-Rodino preliminary injunction hearing regarding anticompetitive impact of a proposed acquisition. (1995)

GAF Corporation, *et al.* (Hannoch Weisman, Roseland, NJ)
Joseph Rossi, et al., vs. Standard Roofing, et al., Civil Action No. 92-5377, United States District Court, District of New Jersey. Prepared Expert Witness Report on behalf of six defendants in antitrust litigation involving conspiracy and monopolization claims. (1995)

Connecticut Light and Power Company
Before the Connecticut Department of Public Utility Control, Investigation into Restructuring of the Electric Industry, *Docket No. 94-12-13.* Submitted Written and Oral Hearing Testimony. (1995)

New England X-Ray & Electronics Inc. (Kushner & Sanders, Wellesley, MA)

New England X-Ray & Electronics Inc. vs. Robert T. Kennedy, Inc., et al., Commonwealth of Massachusetts, Number 88-5532. Presented damages study and jury trial testimony regarding breach of contract. (1990-95)

Florida Gas Transmission Company

Before the Federal Energy Regulatory Commission, Docket No. RP95-103-000, Written Testimony supporting FGT's proposed flexible service offerings, inflation-indexed rate, and removal of regulatory constraints on the secondary market for pipeline capacity. (1995)

Burlington Northern Railroad Company (Steptoe & Johnson, Washington, DC)

Southwestern Electric Power Company, Plaintiff, vs. Burlington Northern Railroad Company, Defendant, in the 102nd Judicial District Court of Bowie County, Texas, No. D-102-CV-91-720. Presented Oral Trial Testimony before a state court jury regarding the pricing provisions in two long-term coal transportation agreements, in defense against a claim by the shipper of overcharges resulting from the contract rates failing to reflect the railroads' productivity improvements. (1994)

Houston Lighting & Power Company

Before the Texas Public Utilities Commission, Docket No. 12065, Written Testimony regarding appropriate regulatory policy changes dictated by emerging competition in electricity markets. (1994)

Boston Ventures Management (Boston)

Prepared a report for a venture capital firm on the adverse consequences on investment of the re-regulation of cable TV. (1994)

Kern River Gas Transmission Company (Salt Lake City)

Before the Public Service Commission of Utah, Application of Mountain Fuel Supply Company for Approval of Modifications to its Tariff to Implement a Firm Transportation Rate, Docket No. 94-057-02. Prepared Prefiled Direct and Rebuttal Testimony, as well as Oral Testimony, before the Public Service Commission of Utah regarding the appropriateness of a firm gas distribution tariff including within it costs of upstream pipeline transportation. (1994)

Burlington Northern Railroad Company (Steptoe & Johnson, Washington, DC)

In the Matter of the Arbitration between Public Service Company of Oklahoma and Burlington Northern Railroad Company. Delivered Written and Oral Testimony concerning the interpretation of the pricing and renegotiation provisions of a long-term coal transportation agreement. (1994)

Arco Pipe Line Company (Steptoe & Johnson, Washington, DC)

Prepared written *Comments in Response to Notice of Inquiry, Market-Based Ratemaking for Oil Pipelines, U.S. Federal Energy Regulatory Commission*, *Docket No. RM94-1-000.* (1994)

Kern River Gas Transmission Company (Wright and Talisman, Washington, DC)

Before the Federal Energy Regulatory Commission In the Matter of Kern River Gas Transmission Company, Docket No. RP92-226-000. Delivered Written and Oral Testimony regarding rate design for pipelines built under optional certificates. (1993)

ISK Biotech Corp. (Beveridge and Diamond, Washington, DC)

In the Matter of the Arbitration between ISK Biotech Corporation and Veterans Chemicals, Prepared Testimony regarding allocation rules and competitive impacts in an arbitration proceeding regarding data compensation under the Federal Insecticide, Fungicide and Rodenticide Act. (1993)

Geneva Steel Corp., *et al.* (Kimball, Parr, Waddoups, Brown & Gee, Salt Lake City)

Before the Utah Public Service Commission Docket No. 93-057-01, Written Testimony regarding antitrust implications of LDC treatment of pipeline charges under FERC *Order 636*, on behalf of a coalition of interruptible shippers. (1993)

Enron Gas Services Corp.

Co-authored study analyzing appropriate Public Utility Commission policy towards utility procurement of natural gas and emissions allowances in developing competitive markets. (1993)

New York Power Authority

Prepared analysis and delivered Public Hearing Testimony before the Board of Trustees regarding the economic consequences of below-market pricing for electricity. (1993)

Coalition of Non-Utility Generators

Co-authored study analyzing the effect of power from non-utility generators on electricity prices in New England. (1993)

U.S. Department of Commerce, Economics and Statistics Administration

Co-authored study analyzing the effect of U.S. environmental regulations on U.S. competitiveness. (1993)

International Energy Group

Before the Federal Energy Regulatory Commission, Docket No. PL91-1-000, Prepared Written Testimony regarding electricity transmission access policy. (June 1991)

El Paso Natural Gas Co. (Andrews & Kurth, Washington, DC)

Before the Federal Energy Regulatory Commission, Docket No. CP88-434-000, Prepared Written Testimony analyzing the extent of competition faced by El Paso as a seller of natural gas. (1989)

RECENT INVITED TALKS

"Evaluating the Performance of Public Research Subsidy Programmes," RIETI-NISTEP Policy Symposium, Tokyo, August 2015

"Promoting Innovation in the Private Sector," Harvard/Tsinghua Workshop on Energy Technology Innovation Policy in the Backdrop of the US/China Emissions Deal, Beijing, June 2015

"The Economics of Science and Science Policy," Speakers Science Series, New Zealand Parliament, December 2014

"Innovation Policy for Australasia," Dimensions of Innovation Conference, Queensland University of Technology, October 2014

"Re-inventing the Kiwi: How to make New Zealand a land of innovation," Dean's Distinguished Speaker Series, University of Auckland Business School, August 2014

"Small Countries in the Global Innovation System," Australian Conference of Economists, Hobart, July 2014

"Measuring the Effect of Government Research Funding: Regression-discontinuity Analysis of the NZ Marsden Fund," Melbourne Institute of Applied Economic and Social Research, July 2014

"Technology Policy and Climate Change," invited seminar at Research Institute of Economy Trade and Industry (REITI), Tokyo, March 2014

BOOKS AND EDITED VOLUMES

The Changing Frontier: Rethinking Science and Innovation Policy (with Benjamin Jones), University of Chicago Press, 2015

Innovation and its Discontents (with J. Lerner), Princeton University Press, 2004; issued in paperback, 2006.

Patents, Citations and Innovations: A Window on the Knowledge Economy (with M. Trajtenberg), M.I.T. Press, 2002; issued in paperback, 2005.

Innovation Policy and the Economy, (edited with J. Lerner and S. Stern), M.I.T. Press, Cambridge, Volume 1 (2001) through Volume 8 (2008)

OTHER PUBLICATIONS

"Patent Citation Data in Social Science Research: Overview and Best Practices" (with Gaétan de Rassenfosse), NBER Working Paper No. 21868 (2016)

"Agricultural productivity in New Zealand: First estimates from the Longitudinal Business Database" (with Eyal Apatov, Richard Fabling, Michele Morris, and Matt Thirkettle), Motu Working Paper 15-13 (2015)

"The Effect of Public Funding on Research Output: the New Zealand Marsden Fund" (with Jason Gush, Victoria Larsen and Athene Laws), Motu Working Paper 15-12 and NBER Working Paper No. 21652 (2015)

"The Impact of R&D Subsidy on Innovation: a Study of New Zealand Firms" (with Trinh Le), Motu Working Paper 15-08; National Bureau of Economic Research Working Paper No. 21479 (2015)

"Technology Diffusion," in ***Emerging Trends in the Social and Behavioral Sciences***, Robert A. Scott and Stephen M. Kosslyn, eds, Wiley Online Library: DOI: 10.1002/9781118900772 (2015)

"Innovation," in ***Emerging Trends in the Social and Behavioral Sciences***, Robert A. Scott and Stephen M. Kosslyn, eds, Wiley Online Library: DOI: 10.1002/9781118900772 (2015)

"The science, economics and politics of global climate change," Review of The Climate Casino, by William Nordhaus (with S. Kerr), ***Journal of Economic Literature***, 2015

"Science and Innovation in Small Countries: Speculation and Research Agenda," ***Asia-Pacific Journal of Accounting and Economics***, http://dx.doi.org/10.1080/16081625.2015.1010267 2015

"Are Patent Fees Effective at Weeding out Low-quality Patents?" (with Gaétan de Rassenfosse) Motu Working Paper 15-01; NBER Working Paper No. 20785, December 2014

"Category 5 or Tempest in a Teapot?" Review of Falling Behind? Boom, Bust and the Global Race for Scientific Talent by Michael S. Teitelbaum, ***Science***, 2 May 2014

"Diffusion of Green Technology" (with C. Allan and I. Sin), ***International Review of Environmental and Resource Economics***, 7: 1–33 (2014)

"Lessons from the Economics Literature on the Likely Consequences of International Harmonization of IPR Protection" (with A.G.Z. Hu), in Intellectual Property Rights: Legal and Economic Challenges for Development, M. Cimoli, G. Dosi, K. Maskus, R. Okediji, and J. Reichman, eds, Oxford University Press, 2014

"Science and Innovation Policy for New Zealand," ***New Zealand Science Review***, 70 (3) 55, 2013

"Technology Policy and Climate Change," ***Climate Change Economics***, 2013

"Induced Innovation and Technology Trajectory: Evidence from Smoking Cessation Products" (with S. Werfel), ***Research Policy***, 2013

"Comment on "The Diffusion of Scientific Knowledge Across Time and Space: Evidence from Professional Transitions for the Superstars of Medicine," in J. Lerner and S. Stern, eds., **Rate and Direction of Inventive Activity**, University of Chicago Press, 2012

"Comment: The Economics of Technologies to Combat Global Warming," ***Energy Economics***, 33:4, 2011

"Analysis of Public Research, Industrial R&D, and Commercial Innovation: Measurement Issues Underlying the Science of Science Policy," in **The Science of Science Policy: A Handbook**, K. Fealing, J. Lane, J. Marburger and S. Shipp, eds., Stanford: Stanford Business Books, 2011

"Energy, the Environment and Technology Change" (with D. Popp and R. Newell), in B. Hall and N. Rosenberg, eds, **Handbook of The Economics of Innovation**, North-Holland, 2010

"The US Patent System: Does It Strengthen or Weaken Innovation and Progress?" (with J. Lerner), Chapter 2.2 of ***The Innovation for Development Report 2009-2010: Strengthening Innovation for the Prosperity of Nations***, Augusto López-Claros, ed, Palgrave MacMillan, 2009

"Patent Reform: No Time Like the Present," ***I/S Journal of Law and Policy for the Information Society,*** 2008

"The 'Science of Science Policy'," ***Journal of Technology Transfer***, 2008

"Double Research Funding? Be Careful," ***The Scientist***, Vol. 21 No. 7, page 31, 2007

"Academic science and entrepreneurship: Dual engines of growth?" (with J. Lerner, S. Stern and M. Thursby), ***Journal of Economic Behavior and Organization***, 2007

"Peanut Butter Patents Versus the New Economy: Does the Increased Rate of Patenting Signal More Invention or Just Lower Standards?" (with P. Sanyal). ***Annales d'Economie et de Statistique***, 2006

"The effects of economic and policy incentives on carbon mitigation technologies," (with R. Newell and R. Stavins), ***Energy Economics*** 28, no. 5-6: 563-578, 2006.

"Public Financial Support for Commercial Innovation" (with I. Goldberg, M, Trajtenberg, T. Muller, J. Sunderland and E. Armas), World Bank. 2006.

"Innovation and Its Discontents" (with J. Lerner), in ***Innovation Policy and the Economy Volume 6***, A. Jaffe, J. Lerner and S. Stern, eds., 2006; reprinted in ***Capitalism and Society*** Vol. 1 No. 3 (2006) and in **Perspectives on Commercializing Innovation**, F. Kieff and Troy Paredes, eds., Cambridge University Press (2012)

"Do Alliances Promote Knowledge Flows" (with B. Gomes-Casseres and John Hagedoorn), ***The Journal of Financial Economics,*** 2006.

"A tale of two market failures: technology and environmental policy" (with R. Newell and R. Stavins), ***Ecological Economics***, 2005; reprinted in **Intellectual Property, Innovation and the Environment**, Peter Menell and Sarah Tran, eds., Edward Elgar (2013).

"Market Value and Patent Citations: A First Look" (with B. Hall and M. Trajtenberg), ***Rand Journal of Economics***, 2005

Comment on "Patent Citations and the Geography of Spillovers: A Reassessment" (with R. Henderson and M. Trajtenberg), ***American Economic Review***, 2005

"Economics of Energy Conservation" (with R.G. Newell and R. N. Stavins), in Cutler Cleveland, ed., *Encyclopedia of Energy* , Elsevier, Inc. 2004.

"Patent Citations and International Knowledge Flow: The Cases of Korea and Taiwan" (with A. Hu), ***International Journal of Industrial Organization***, 2004

"Technological Change and the Environment" (with R. Newell and R. Stavins), in K.-G. Mäler and J. Vincent, eds., *Handbook of Environmental Economics*, North-Holland, 2003.

"Environmental Policy and Technological Change" (with R. Newell and R. Stavins), *Environmental and Resource Economics*, 2002.

"Building Programme Evaluation into the Design of Public Research-Support Programmes," *Oxford Review of Economic Policy,* 2002.

"Reinventing Public R&D: Patent Policy and the Commercialization of National Laboratory Technologies" (with J. Lerner), *Rand Journal of Economics*, Spring 2001.

"International Taxation and the Location of Incentive Activity" (with J.R. Hines, Jr.), in J.R. Hines, Jr., ed., *International Taxation and Multinational Activity*, University of Chicago Press, 2001.

"Knowledge Spillovers and Patent Citations: Evidence from a Survey of Inventors" (with M. Trajtenberg and M. Fogarty), *American Economic Review Papers and Proceedings*, May 2000.

"The Cigarette Industry," in W. Adams and J. Brock, eds., *The Structure of American Industry*, 10th edition, Prentice Hall, 2000.

"The U.S. Patent System in Transition: Policy Innovation and the Innovation Process," *Research Policy,* April 2000.

"Energy-Efficient Technologies and Climate Change Policies: Issues and Evidence" (with R. Newell and R. Stavins), Resources for the Future Climate Issue Brief No. 19, December 1999.

"The Regional Economic Impact of Public Research Funding: A Case Study of Massachusetts" (with A.B. Candell), in L.M. Branscomb, F. Kodama, and R. Florida, eds., *Industrializing Knowledge: University-Industry Linkages in Japan and the United States,* MIT Press, 1999.

"The Induced Innovation Hypothesis and Energy-Saving Technological Change" (with R. Newell and R. Stavins), *Quarterly Journal of Economics*, August 1999; reprinted in A. Grübler, N. Nakicenovic, and W. Nordhaus, eds., *Technological Change and the Environment*, Resources for the Future, 2002.

"The Pipeline's View: FERC's Proposed Rule Misses" (with J. Lukens), *Public Utilities Fortnightly*, July 1, 1999.

"Special Issue on Geography and Innovation" (with R. Henderson), introduction to *Economics of Innovation and New Technology,* Vol. 8, 1999.

"International Knowledge Flows: Evidence from Patent Citations" (with M. Trajtenberg), *Economics of Innovation and New Technology,* Vol. 8, 1999.

Comment on "Inventors, Firms and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries," in D. Raff, N. Lamoreaux and P. Temin, eds., *Learning by Doing in Markets, Firms, and Nations*, The University of Chicago Press, 1999.

"The Importance of 'Spillovers' in the Policy Mission of the Advanced Technology Program," *Journal of Technology Transfer*, Summer 1998.

"Inside the Pin-Factory: Empirical Studies Augmented by Manager Interviews: Introduction" (with Severin Borenstein and Joseph Farrell), *Journal of Industrial Economics*, June 1998.

"Evidence from Patents and Patent Citations on the Impact of NASA and Other Federal Labs on Commercial Innovation" (with Bruce A. Banks and Michael S. Fogarty), *Journal of Industrial Economics*, June 1998.

Comment on "What Do Technology Shocks Do?" in Bernanke, Ben S., and Julio Rotemberg, eds., *NBER Macroeconomics Annual, 1998.*

"Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988" (with Rebecca Henderson and M. Trajtenberg), *Review of Economics and Statistics*, February 1998; also published in a slightly different form as "University Patenting Amid Changing Incentives for Commercialization" in G.B. Navaretti, P. Dasgtupta, K.-G. Maler and D. Siniscalco, eds., *Creation and Transfer of Knowledge*, Springer, 1998.

"Measurement Issues," in L.M. Branscomb & J. Keller, eds., *Investing in Innovation*, MIT Press, 1998.

"University Versus Corporate Patents: A Window on the Basicness of Invention" (with M. Trajtenberg and R. Henderson), *Economics of Innovation and New Technology*, 1997.

"Environmental Regulation and Innovation: A Panel Data Study" (with K. Palmer), *Review of Economics and Statistics*, November 1997.

Review of *Green, Inc.*, by Frances Cairncross, *Journal of Economics Literature*, March 1997.

"Bounding the Effects of R&D: An Investigation Using Linked Establishment and Firm Data" (with J. Adams), *Rand Journal of Economics,* winter 1996

"Economic Analysis of Research Spillovers: Implications for the Advanced Technology Program," Economic Assessment Office, The Advanced Technology Program, National Institutes of Standards and Technology, U.S. Department of Commerce, November 1996.

"Flows of Knowledge from Universities and Federal Labs: Modelling the Flow of Patent Citations over Time and across Institutional and Geographic Boundaries" (with M. Trajtenberg), *Proceedings of the National Academy of Sciences,* Vol. 93, pp. 12671-12677, November 1996.

"Trends and Patterns in U.S. Research and Development Expenditures," *Proceedings of the National Academy of Sciences*, Vol. 93, pp. 12658-12663, November 1996.

"Should Electricity Markets Have A Capacity Requirement: If So, How Should It Be Priced?" (with F. Felder), *The Electricity Journal*, December 1996.

"Regional Localization of Technological Accumulation: Application to the Tri-State Region," *The Annals of the New York Academy of Sciences,* 1996.

Comment on "Cross-Country Variations in National Economic Growth Rates" by J. Bradford Delong, in *Technology and Growth*, J.C. Fuhrer and J. Sneddon Little, eds., Federal Reserve Bank of Boston Conference Series No. 40, June 1996.

"Regulatory Reform and the Economics of Contract Confidentiality: The Example of Natural Gas Pipelines" (with J. P. Kalt, S. T. Jones, and F. A. Felder), *Regulation*, 1996, No 1.

"Planning for Change, Preparing for Growth: Implications for Massachusetts of Reductions in Federal Research Spending" (with Amy B. Candell, Kenneth W. Grant, Michael Laznik, and Kelly T. Northrop), The Economics Resource Group, Inc., funded by the Massachusetts Technology Collaborative, February 1996.

"Incentive Regulation for Natural Gas Pipelines" (with J. Kalt), in Ellig, J. and J. P. Kalt, eds., *New Horizons in Natural Gas Deregulation*, Praeger, 1996.

"The Emerging Coexistence of Competition and Regulation in Natural Gas Transportation" (with S. Makowka), *Hume Papers on Public Policy*, 1995.

"On the Microeconomics of R&D Spillovers" (with J. Adams), in Louis Lefebvre, ed., *Technology Management*, Paul Chapman Publishing, Ltd., 1995.

"An Economic Analysis of Electricity Industry Restructuring in New England" (with J. P. Kalt), The Economics Resource Group, Inc., funded by Northeast Utilities System Companies, April 1995.

"Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion" (with R. Stavins), *Journal of Environmental Economics and Management,* 1995.

"Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?" (with S. Peterson, P. Portney and R. Stavins), *The Journal of Economic Literature*, 1995; reprinted in Alan M. Rugman and John J. Kirton, eds., *Trade and the Environment: Economic, Legal and Policy Perspectives*, Cheltenham, UK: Edward Elgar Publishing Limited, 1998.

Comment on "Taxes, Technology Transfer, and the R&D Activities of Multinational Firms" by James R. Hines, Jr., in Martin Feldstein, James R. Hines, Jr., and R. Glenn Hubbard, eds., *The Effects of Taxation on Multinational Corporations*, University of Chicago Press, 1995.

"The Energy-Efficiency Gap" (with R. Stavins), *Energy Policy*, 1994.

"The Investment Consequences of the Re-Regulation of Cable Television" (with W. Emmons and J. Taylor), The Economics Resource Group, Inc., Cambridge MA, 1994.

"Insight on Oversight" (with J. Kalt), *Public Utilities Fortnightly*, April 15, 1994.

"The Energy Paradox and the Diffusion of Conservation Technology" (with R. Stavins), *Resource and Energy Economics*, 1994.

"Energy-Efficiency Investments and Public Policy" (with R. Stavins), *The Energy Journal*, 1994.

"Prices, Regulation and Energy Conservation: An Econometric Analysis" (with R. Stavins), delivered at the Conference on Market Approaches to Environmental Regulation, Stanford University, December 1993.

Comment on "R&D and Market Value in the 1980s" by Bronwyn Hall, *Brookings Papers on Economic Activity, Microeconomics,* 1993.

"The Effect of Liquidity on Firms' R&D Spending" (with K. Hao), *Economics of Innovation and New Technology*, 1993.

"Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations" (with M. Trajtenberg and R. Henderson), *Quarterly Journal of Economics*, August 1993.

"Environmental Regulations and the Competitiveness of U.S. Industry" (with S. Peterson, P. Portney, and R. Stavins), U.S. Department of Commerce, Economics and Statistics Administration, Washington, DC, NTIS No. PB-93-193514, July 1993.

"Oversight of Regulated Utilities' Fuel Supply Contracts: Achieving Maximum Benefit from Competitive Natural Gas and Emission Allowance Markets" (with J. P. Kalt), The Economics Resource Group, funded by Enron Gas Services Corporation, April 1993.

"Achieving Maximum Benefit from Competitive Natural Gas and Emission Allowance Markets" (with J. Kalt), *Proceedings of the U.S. Department of Energy/National Association of Regulatory Utility Commissioners Conference on Natural Gas Use, State Regulation and Market Dynamics in the Post 636/Energy Policy Act Era*, March 1993.

"The Diffusion of Energy-Conserving Windows: The Effect of Economic Incentives and Building Codes" (with R. Stavins), presented at the American Economic Association annual meeting, Anaheim CA, January 1993.

"How High are the Giants' Shoulders: An Empirical Assessment of Knowledge Spillovers and Creative Destruction in a Model of Economic Growth" (with R. Caballero), in O. Blanchard and S. Fischer, eds., *National Bureau of Economic Research Macroeconomics Annual, Vol. 8*, MIT Press, 1993; reprinted in Gene M. Grossman, ed., *Economic Growth: Theory and Evidence*, Vol. II, Cheltenham, UK: Edward Elgar Publishing Limited, 1996.

Review of *Investing in the Future*, by John Irvine, *et al.*, *Journal of Economic Literature*, June, 1992.

Review of *Productivity and U.S. Economic Growth* by D. Jorgenson, *et al.*, *Business History Review*, 1991.

"Evaluating the Relative Effectiveness of Economic Incentives and Direct Regulation for Environmental Protection: Impacts on the Diffusion of Technology" (with R. Stavins), *CSIA Discussion Paper No. 91-1*, Center for Science and International Affairs, Environment and Natural Resources Program, John F. Kennedy School of Government, Harvard University, February 1991.

"Economic Evaluation of Policy Options for Global Climate Change: Some Methodological Reflections," Center for Energy and Environmental Policy, John F. Kennedy School of Government, Harvard University, August 1990.

"Market Power of Local Cable Television Franchises: Evidence from the Effects of Deregulation" (with D. Kanter), *Rand Journal of Economics*, summer 1990.

"Unintended Impacts of Public Investments on Private Decisions: The Depletion of Forested Wetlands" (with R. Stavins), *American Economic Review*, June 1990.

"Universities and Regional Patterns of Commercial Innovation," *REI Review*, Center For Regional Economic Issues, Case-Western Reserve University, 1989.

"Real Effects of Academic Research," *American Economic Review*, December 1989; reprinted in Paula E. Stephan and David B. Audretsch, eds., *The Economics of Science and Innovation*, Cheltenham, UK: Edward Elgar Publishing Limited, 2000.

"Characterizing the 'Technological Position' of Firms, with Application to Quantifying Technological Opportunity and Research Spillovers," *Research Policy*, 1987.

"Demand and Supply Influences in R&D Intensity and Productivity Growth," *Review of Economics and Statistics*, August 1988.

"Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value," *American Economic Review*, December 1986; reprinted in Edward N. Wolff, ed., *The Economics of Productivity,* Cheltenham, UK: Edward Elgar Publishing Limited, 1997.

"Who Does R&D and Who Patents" (with J. Bound, *et al.*), in Z. Griliches, ed., *R&D, Patents and Productivity*, University of Chicago Press, 1984.

"Benefit-Cost Analysis and Multi-Objective Evaluation of Federal Water Projects," *Harvard Environmental Law Review*, 1980.

"Preventing Groundwater Pollution: Towards a Coordinated Strategy to Protect Critical Recharge Zones (with J.T.B. Tripp), *Harvard Environmental Law Review*, 1979.

OTHER PROFESSIONAL ACTIVITIES

Member, Ministry of Business, Innovation and Employment Science Board, 2014 ongoing

Board Member, Asia-Pacific Innovation Conference, 2013 ongoing

Conference Co-Organizer, "The Changing Frontier: Rethinking Science and Innovation Policy," National Bureau of Economic Research, August 2013

Editorial Board, Environmental Innovation and Societal Transitions, 2011 ongoing

Lead Author, Fifth Assessment Report, Intergovernmental Panel on Climate Change, 2011-2013

Invited Participant, NIH Science of Science Management meeting, October 2008

Consultant, Finance Ministry, Government of Chile, 2007

Keynote address, NSF Workshop on Advancing Measures of Innovation: Knowledge Flows, Business Metrics and Measurement Strategies, Arlington VA, 2006

Consultant, World Bank (evaluation of program in El Salvador to increase productivity in SME), 2006

Member, Board of Editors, Journal of Industrial Economics, 1995-2003; American Economic Review, 1995-2000; Associate Editor, Rand Journal of Economics, 1997-2003

Guest Associate Editor, Management Science Special Issue: "Managing Knowledge in Organizations," 2001

Lead Author, Third Assessment Report, Intergovernmental Panel on Climate Change, 1998-2001

Member, National Academy of Engineering Committee on the Impact of Academic Research on Industrial Performance, 1998-2001

Member, Economic Impact Committee, Association of University Technology Managers, 1994-95

Contributing Author, Working Group III (socioeconomics) of the Intergovernmental Panel on Climate Change (IPCC), 1994

Member, Stanford Energy Modeling Forum, Working Group on Energy Conservation (EMF 13), 1992-94

Referee/Reviewer for American Economic Review, Econometrica, Economic Inquiry, Economics of Innovation and New Technology, Journal of Economics Organization and Management, Journal of Environmental Economics and Management, Journal of Industrial Economics, Journal of Law and Economics, Journal of Political Economy, Quarterly Journal of Economics, Rand Journal of Economics, Research Policy, Review of Economics and Statistics, Science, and MIT Press.

TEACHING EXPERIENCE

Introductory Economics (undergraduate), Microeconomic Theory (Ph.D.), Law and Economics (undergraduate), Environmental and Natural Resource Economics (undergraduate), Industrial Organization (Ph.D. and undergraduate), Government Regulation and Antitrust Policy (Ph.D. and undergraduate), R&D, Innovation and Productivity Growth (undergraduate), Applied Welfare Economics (John F. Kennedy School of Government)

Foundation for American Communications, economics education for journalists, "The Role of Government in the Economy" (1996)

Designed and implemented a two-year Policy Analysis Lecture Series for the U.S. Army Corps of Engineers, New England Division, Regulatory Branch (1988-89)

HONORS AND AWARDS

Venice Award for Intellectual Property, Honorable Mention for Innovation and Its Discontents (2007)

Alfred P. Sloan Dissertation Fellowship, Harvard, 1984-85

Alfred P. Sloan Research Fellowship, MIT, 1976-77

Phi Beta Kappa, 1976

APPENDIX B: MATERIALS CONSIDERED

A. Bates Documents

- GOOG-00130338.
- GOOGLE-01-00017154.
- GOOGLE-01-00018141.
- GOOGLE-01-00019511.
- GOOGLE-01-00035931.
- GOOGLE-01-00066237.
- GOOGLE-01-00066262.
- GOOGLE-01-00148180.
- GOOGLE-02-00020474.
- GOOGLE-02-00359548.
- GOOGLE-03-00067085.
- GOOGLE-03-00139402.
- GOOGLE-03-00146539.
- GOOGLE-03-00147537.
- GOOGLE-22-00051824.
- GOOGLE-22-00072075.
- GOOGLE-22-00072076.
- GOOGLE-22-00073880.
- GOOGLE-22-00122689.
- GOOGLE-22-00124385.
- GOOGLE-22-00171914.
- GOOGLE-23-00000049.
- GOOGLE-24-00010460.
- GOOGLE-24-00013099.
- GOOGLE-24-00015101.
- GOOGLE-24-00015413.
- GOOGLE-24-00017719.
- GOOGLE-24-00019558.
- GOOGLE-24-00138208.

- GOOGLE-24-00147891.
- GOOGLE-24-00152227.
- GOOGLE-24-00206924.
- GOOGLE-26-00005730.
- GOOGLE-29-00002088.
- GOOGLE-38-00127518.
- GOOGLE-56-00017329.
- GOOGLE-56-00017330.
- GOOGLE-56-00017401.
- GOOGLE-56-00018960.
- GOOGLE-59-00014897.
- GOOGLE-67-00040897.
- OAGOOGLE0000424812.
- OAGOOGLE0001049230.
- OAGOOGLE0100167800.

B. Public Documents

- Aguirregabiria, Victor and Aviv Nevo, "Recent Developments in Empirical IO: Dynamic Demand and Dynamic Games," Advances in Economics and Econometrics: Theory and Applications: Tenth World Congress, 2013.
- Alistair Barr, Google Gives Up on Google+ as a Facebook Rival, WSJ (Jul. 27, 2015), http://blogs.wsj.com/digits/2015/07/27/google-gives-up-on-google-as-a-facebook-rival/.
- Alistair Barr, Google is Shutting Down Orkut, Its First Effort at Social Networking, WSJ (Jun. 30, 2014), http://blogs.wsj.com/digits/2014/06/30/google-is-shutting-down-orkut-its-first-effort-at-social-networking/.
- Apple Reinvents the Phone with iPhone, Apple (Jan. 9, 2007), http://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html.
- Berry, Steven, and Joel Waldfogel. Product Quality and Market Size, The Journal of Industrial Economics 58.1 (2010): 1-31.
- Chris Ziegler, Nokia buys Symbian, turns software over to Symbian Foundation, Engadget (June 24, 2008), http://www.engadget.com/2008/06/24/nokia-buys-symbian/.

- Dan Fletcher, Microsoft Bob, Time (May 27, 2010), http://content.time.com/time/specials/packages/article/0,28804,1991915_1991909_1991855,00.html.
- Daniel Eran Dilger, The Spectacular Failure of WinCE and Windows Mobile, Roughly Drafted (Jan. 27, 2007), http://www.roughlydrafted.com/RD/RDM.Tech.Q1.07/50755EA6-A759-42FD-84ED-EBB5A060AF16.html.
- Evans, David S. and Richard Schmalensee, "Failure to Launch: Critical Mass in Platform Businesses," Review of Network Economics 9.4 (2010).
- Farrell, Joseph and Paul Klemperer, "Coordination and Lock-In: Competition with Switching Costs and Network Effects," in Handbook of Industrial Organization, Vol 3; M. Armstrong and R. Porter (eds.), North-Holland (2007).
- Gartner Says Emerging Markets Drove Worldwide Smartphone Sales to 15.5 Percent Growth in Third Quarter of 2015, Gartner (Nov. 18, 2015), http://www.gartner.com/newsroom/id/3169417.
- Gartner Says Worldwide Mobile Device Sales to End Users Reached 1.6 Billion Units in 2010; Smartphone Sales Grew 72 Percent in 2010, Gartner (Feb. 9, 2011), http://www.gartner.com/newsroom/id/1543014.
- Gartner Says Worldwide Smartphone Sales Reached Its Lowest Growth Rate With 3.7 Per Cent Increase in Fourth Quarter of 2008. Gartner (Mar. 11, 2009), http://www.gartner.com/newsroom/id/910112.
- Google Buys Android for its Mobile Arsenal, Bloomberg Business, http://www.bloomberg.com/bw/stories/200508-16/google-buys-android-for-its-mobile-arsenal.
- Google SEC Form 10-K (2004).
- Google SEC Form 10-K (2007).
- Gowrisankaran, Gautam and Marc Rysman, "Dynamics of Consumer Demand for New Durable Goods," Journal of Political Economy, 2012.
- Kristin Burnham, Apple Dumps Google Search For Microsoft's Bing, Information Week (Jun. 3, 2014), http://www.informationweek.com/software/operating-systems/apple-dumps-google-search-for-microsofts-bing/d/d-id/1269398.
- Lee, Robin S., "Vertical Integration and Exclusivity in Platform and Two-Sided Markets," American Economic Review, 2013.
- M.J. Kim, Essays on the Economics of the Smartphone and Application Industry, University of Minnesota (2013).

- Maggie Lake, How BlackBerry conquered the world, CNN (Mar. 23, 2005), http://www.cnn.com/2005/BUSINESS/03/23/blackberry.rim/.
- Marc Rysman, The Economics of Two-Sided Markets, 23(3) J. Econ. Perspectives 125 (2009).
- Mat Honan, Remembering the Apple Newton's Prophetic Failure and Lasting Impact, Wired (Aug. 05, 2013), http://www.wired.com/2013/08/remembering-the-apple-newtons-prophetic-failure-and-lasting-ideals/.
- Michael Arrington, Three's Company Or Three's A Crowd? Google To Launch "Friend Connect" On Monday, TechCrunch (May, 9, 2008), http://techcrunch.com/2008/05/09/threes-company-google-to-launch-friend-connect-on-monday/.
- Michael Katz and Carl Shapiro, Network Externalities, Competition, and Compatibility, 75 (3) The American Economic Review (1985).
- Michael S. Malone, DEC's Final Demise, Forbes (Sept. 15, 2000), http://www.forbes.com/2001/01/19/0915malone.html.
- Microsoft Releases Next-Generation PDA, the Pocket PC, Microsoft (Apr. 19, 2000), http://news.microsoft.com/2000/04/19/microsoft-releases-next-generation-pda-the-pocket-pc/.
- Mobile leaders to unify the Symbian software platform and set the future of mobile, NTT DoCoMo (Jun. 24, 2008), freehttps://www.nttdocomo.co.jp/english/info/media_center/pr/2008/001408.html.
- More spring cleaning out of season, Google (Nov. 22, 2011), https://googleblog.blogspot.com/2011/11/more-spring-cleaning-out-of-season.html.
- Nathan Ingraham, Ping, Apple's failed music-focused social network, is officially closed as of today, The Verge (Oct. 1, 2012), http://www.theverge.com/2012/10/1/3439168/ping-apple-music-social-network-closed.
- Nokia acquires Symbian Limited, Nokia (Dec. 2, 2008), http://company.nokia.com/en/news/press-releases/2008/12/02/nokia-acquires-symbian-limited.
- Nokia and Vodafone to lead roadmap for mobile Java standards, Vodafone (26 Sep 2004), http://www.vodafone.com/content/index/media/vodafone-group-releases/2004/press_release26_08.html.
- Our History In Depth, Google, https://www.google.com/about/company/history/ (Last accessed Feb. 23, 2016).
- Quan, Thomas, and Kevin Williams, Product Variety, Across-Market Demand Heterogeneity, and the Value of Online Retail, (2016).

- T. Bresnahan, et al., Platform Choice by Mobile App Developers, Stanford University (May 29, 2014).
- T. Bresnahan, J. Davis, and P.L. Yin, Economic Value Creation in Mobile Applications, The Changing Frontier: Rethinking Science and Innovation Policy (A. Jaffe and B. Jones, eds., 2015).
- Zhu, Feng, and Marco Iansiti. "Entry into platform-based markets." Strategic Management Journal 33.1 (2012).

C. Court Documents

- Deposition of Andy Rubin, Apr. 5, 2011.
- Deposition of Andy Rubin, Jul. 27, 2011.
- Deposition of Gregory Leonard, Oct. 28, 2011.
- Deposition of Jon Gold, Dec. 11, 2015.
- PX 185.
- TX 1, (GOOGLE-00001779).
- TX 10, (GOOGLE-12-10000022).
- TX 13, (GOOGLE-01-00019511-513).
- TX 134.
- TX 154
- TX 158.
- TX 215, (GOOGLE-01-00081881).
- TX 23, (GOOGLE-04-00055098).
- TX 7 (GOOGLE-01-00019527).
- TX 8 (GOOGLE-01-00019529).

D. Expert Reports

- Expert Report of Dr. Adam Jaffe, Feb. 8, 2016.
- Expert Report of Dr. Gregory K. Leonard, Feb. 8, 2016.
- Expert Report of Gwyn Murray, Feb. 8, 2016.

APPENDIX C: ORACLE V. GOOGLE - CHART OF ANDROID PRESENTATIONS

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

LG	OEM	7-7-2006	"Project Android"	• Android stack block diagram, at -233
				  ○ Core Java Libs
				  ○ Java Virtual Machine
				• Graphics Architecture block diagram, at -239
				  ○ Java API (SGL, MIDP, OGL etc…)
				• Dalvik Runtime, at -249
				  ○ Java compatible
				  ○ Runs standard Java .class/ .jar files
				• Application Framework, at -251
				  ○ Standard Java class libraries
				• Developer Tools, at -268
				  ○ Java debugging
					GOOGLE-24-00152227
					
					(Parent: GOOGLE-24-00152155)

BenQ	OEM	9-19-2006	Android BenQ technical overview	• Baseline Features, at -105
				  ○ Java J2ME and CDC 1.1 (JSR-218), foundation profile (JSR-219)
				  ○ MIDP 2.0
				  ○ JSRs
				  ▪ JSR-82 (Bluetooth)
				  ▪ JSR-75 (PDA Optional Packages)
				  ▪ JSR-120/205 (Wireless Messaging API)
				  ▪ JSR-135/234 (Multimedia API)
				• Supporting Java is the best way to harness developers, at -111
				  ○ Fact: Linux fragmentation threatens market acceptance. Tools and new app frameworks are biggest hurdles. 6M Java developers worldwide. Tools and documentation exist to support app development without the need to create a large developer services organization. There exist many legacy Java applications. The wireless industry has adopted Java, and the carriers require its support.
				
				  ○ Strategy: Leverage Java for its existing base of developers. Build a useful app framework (not J2ME). Support J2ME apps in compatibility mode. Provide an optimized JVM (Dalvik).
					GOOGLE-24-00013099
					
					(BenQ Minutes of meeting: GOOGLE-01-00148040)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

				• Android architecture = Standards based, no fragmentation, at 112
				  ○ Android stack block diagram
				  ▪ Runtime: Core Java Libs; Java Virtual Machine
				  ▪ MIDP/JSRs
				  ▪ MIDP Apps
				• Platform Technical Overview—Graphics Architecture, at -121
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -131
				  ○ Java compatible
				  ○ Runs standard Java .class/.jar files
				• Application Framework, at -132
				  ○ Standard Java class libraries
				  ○ MIDP 2.0 support
				• Developer Tools, at -143
				  ○ Java debugging
				• Platform Status, at -145
				  ○ Java application framework and model implemented and sufficient for app development	

China Mobile	Carrier	9-28-2006	Android Open Handset Platform	• Improving the core platform, at 8
				  ○ Google & Alliance will make the integrated Java/Linux Mobile Platform available through an open source distribution
				  ○ The Java platform will be CDC based with the ability to run all the midlet-base content
				• Supporting Java is the best way to harness developers, at 10
				  ○ Fact: Linux fragmentation threatens value. Tools and new app frameworks are biggest hurdles. 6M Java developers worldwide. Tools and documentation exist to support app development without the need to create a large developer services organization. There exist many legacy Java applications. The wireless industry has adopted Java, and the carriers require its support.
				  ○ Strategy: Leverage Java for its existing base of developers. Build a useful app framework (not J2ME). Support J2ME apps in compatibility mode. Provide an optimized JVM (Dalvik). Integrate class libraries and
					TX 158

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

				other technology from Skelmir acquisition to accelerate effort.
				• Appendix – Google handset OS architecture, at 13
				  ○ Android stack block diagram
				  ▪ Runtime: Core Java Libs; Java Virtual Machine
				  ▪ MIDP/JSRs
				  ▪ MIDP Apps	

T-Mobile	Carrier	11-9-2006	The Google Phone	• Baseline Features, at 34
				  ○ Java J2ME and CDC 1.1 (JSR-218), foundation profile (JSR-219)
				  ○ MIDP 2.0
				  ○ JSRs
				  ▪ JSR-82 (Bluetooth)
				  ▪ JSR-75 (PDA Optional Packages)
				  ▪ JSR-120/205 (Wireless Messaging API)
				  ▪ JSR-135/234 (MulT-Mubileedia API)
				• Supporting Java is the best way to harness developers, at 40
				  ○ Fact: Linux fragmentation threatens market acceptance. Tools and new app frameworks are biggest hurdles. 6M Java developers worldwide. Tools and documentation exist to support app development without the need to create a large developer services organization. There exist many legacy Java applications. The wireless industry has adopted Java, and the carriers require its support.
				  ○ Strategy: Leverage Java for its existing base of developers. Build a useful app framework (not J2ME). Support J2ME apps in compatibility mode. Provide an opT-Mobileized JVM (Dalvik).
				• Android architecture = Standards based, no fragmentation, at 41
				  ○ Android stack block diagram
				  ▪ Runtime: Core Java Libs; Java Virtual Machine
				  ▪ MIDP/JSRs
				  ▪ MIDP Apps
				• Platform Technical Overview—Graphics Architecture, at 50
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at 60
					TX 387

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				○ Java compatible ○ Runs standard Java .class/.jar files • Application Framework, at 61 ○ Standard Java class libraries ○ MIDP 2.0 support • Developer Tools, at 72 ○ Java debugging • Platform Status, at 74 ○ Java application framework and model implemented and sufficient for app development	
Cingular	Carrier	12-14-2006	The Google Phone	• Developer Tools, at -914 ○ Java debugging • Project Android, at -941 ○ Java virtual machine for middleware and apps • Android Advantages, at -942 ○ Powerful, simple Java Application Framework • Android stack block diagram, at -943 ○ Runtime: Core Java Libs; Java Virtual Machine ○ MIDP/JSRs ○ MIDP Apps • Graphics Architecture, at -948 ○ Application processes: Java API (SGL, MIDP, OGL) • Dalvik Runtime, at -958 ○ Java compatible ○ Runs standard Java .class/.jar files • Application Framework, at -959 ○ Standard Java class libraries ○ MIDP 2.0 support	GOOGLE-59-00014898 (Parent: GOOGLE-59-00014897)
Sprint	Carrier	12-[]-2006	The Google Phone	• Developer Tools, at -952 ○ Java debugging • Project Android, at -969 ○ Java virtual machine for middleware and apps • Android Advantages, at -970 ○ Powerful, simple Java Application Framework • Android stack block diagram, at -971 ○ Runtime: Core Java Libs; Java Virtual Machine ○ MIDP/JSRs ○ MIDP Apps	GOOGLE-24-00206924

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

				• Graphics Architecture, at -976
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -986
				  ○ Java compatible
				  ○ Runs standard Java .class/.jar files
				• Application Framework, at -987
				  ○ Standard Java class libraries
				  ○ MIDP 2.0 support	

Vodafone	Carrier	2-[]-2007	A Google Enabled Phone	• Developer Tools, at -574
				  ○ Java debugging
				• Project Android, at -582
				  ○ Java virtual machine for middleware and apps
				• Android Advantages, at -583
				  ○ Powerful, simple Java Application Framework
				• Android stack block diagram, at -584
				  ○ Runtime: Core Java Libs; Java Virtual Machine
				  ○ MIDP/JSRs
				  ○ MIDP Apps
				• Graphics Architecture, at -589
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -599
				  ○ Java compatible
				  ○ Runs standard Java .class/.jar files
				• Application Framework, at -600
				  ○ Standard Java class libraries
				  ○ MIDP 2.0 support
					GOOGLE-24-00019558
					
					(Parent: GOOGLE-24-00019557)

LG	OEM	3-11-2007	Project Android	• Project Android, at -240
				  ○ Java virtual machine for middleware and apps
				• Android Advantages, at -241
				  ○ Powerful, simple Java Application Framework
				• Android stack block diagram, at -245
				  ○ Runtime: Core Java Libs; Java Virtual Machine
				  ○ MIDP/JSRs
				  ○ MIDP Apps
				• Graphics Architecture, at -251
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -261
				  ○ Java compatible
					GOOGLE-01-00066237
					
					(Parent: GOOGLE-01-00066236)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				○ Runs standard Java .class/.jar files	
Qualcomm	OEM	3-27-2007	Project Android	• Project Android, at -540 ○ Java virtual machine for middleware and apps • Android Advantages, at -541 ○ Powerful, simple Java Application Framework • Android stack block diagram, at -542 ○ Runtime: Core Java Libs; Java Virtual Machine ○ MIDP/JSRs ○ MIDP Apps • Graphics Architecture, at -547 ○ Application processes: Java API (SGL, MIDP, OGL) • Dalvik Runtime, at -558 ○ Java compatible ○ Runs standard Java .class/.jar files	GOOGLE-03-00146539 (Parent: GOOGLE-03-00146537)
Samsung	OEM	4-7-2007	Google's answers to Samsung's questionnaire	• Samsung question no. 7: How to test Java Runtime (Core Java Libraries & Dalvik Virtual Machine). Any test suite available? [Google answer:] We are currently developing a test suite, which will be complete later this year. Our test suite is intended to have good coverage by the time we have Release Candidate SW. Samsung is welcome to run their own test suites at any time. • Samsung question no. 16: We need to have a technical session regarding the software architectures: * Windows system, multimedia framework, Dalvik JVM, and other subjects on Resource isolation/management mechanism, multiple VM mechanism, JIT mechanism, and java libraries. [Google answer:] Our application framework lead will be at the face-to-face meeting to give you an overview of our system.	GOOGLE-56-00018960 (Parent: GOOGLE-56-00018958)
Docomo	Carrier	4-9-2007	Open Handset Distribution	• What is Google's Open Handset Distribution? at -091 ○ Java Application Framework for all middleware and all applications ▪ Blazingly fast Java implementation • Open Handset Distribution Architecture, at -092 ○ Android stack block diagram, at - ▪ Runtime: Core Java Libs; Java Virtual Machine	GOOGLE-29-00002088 (Parent: GOOGLE-29-00002087)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ MIDP/JSRs ▪ MIDP Apps • Open Handset Distribution Applications, at -093 o Open platform allows thousands of Java developers to easily create unique applications • Project Android, at -107 o Java virtual machine for middleware and apps • Android stack block diagram, at -108 o Runtime: Core Java Libs; Java Virtual Machine o MIDP/JSRs o MIDP Apps • Graphics Architecture, at -113 o Application processes: Java API (SGL, MIDP, OGL) • Dalvik Runtime, at -123 o Java compatible o Runs standard Java .class/.jar files • Application Framework, at -124 o Standard Java class libraries o MIDP 2.0 support	
Sprint	Carrier	4-24-2007	Google Powered Phone	• Developer Tools, at -490 o Java debugging • Project Android, at -507 o Java virtual machine for middleware and apps • Android Advantages, at -508 o Powerful, simple Java Application Framework • Android stack block diagram, at -509 o Runtime: Core Java Libs; Java Virtual Machine o MIDP/JSRs o MIDP Apps • Graphics Architecture, at -514 o Application processes: Java API (SGL, MIDP, OGL) • Dalvik Runtime, at -524 o Java compatible o Runs standard Java .class/.jar files • Application Framework, at -525 o Standard Java class libraries o MIDP 2.0 support	GOOGLE-24-00010460 (Parent: GOOGLE-24-00010459)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

Telefonica	Carrier	5-9-2007	A Google Enabled Phone	• Developer Tools, at -118
				  ○ Java debugging
				• Project Android, at -125
				  ○ Java virtual machine for middleware and apps
				• Android Advantages, at -126
				  ○ Powerful, simple Java Application Framework
				• Android stack block diagram, at -127
				  ○ Runtime: Core Java Libs; Java Virtual Machine
				  ○ MIDP/JSRs
				  ○ MIDP Apps
				• Graphics Architecture, at -132
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -142
				  ○ Java compatible
				  ○ Runs standard Java .class/.jar files
				• Application Framework, at -143
				  ○ Standard Java class libraries
				  ○ MIDP 2.0 support
					GOOGLE-24-00015101
					
					(Parent: GOOGLE-24-00015100)

Orange	Carrier	5-10-2007	A Google Enabled Phone	• Developer Tools, at -430
				  ○ Java debugging
				• Project Android, at -437
				  ○ Java virtual machine for middleware and apps
				• Android Advantages, at -438
				  ○ Powerful, simple Java Application Framework
				• Android stack block diagram, at -439
				  ○ Runtime: Core Java Libs; Java Virtual Machine
				  ○ MIDP/JSRs
				  ○ MIDP Apps
				• Graphics Architecture, at -444
				  ○ Application processes: Java API (SGL, MIDP, OGL)
				• Dalvik Runtime, at -454
				  ○ Java compatible
				  ○ Runs standard Java .class/.jar files
				• Application Framework, at -455
				  ○ Standard Java class libraries
				  ○ MIDP 2.0 support
					GOOGLE-24-00015413
					
					(Parent: GOOGLE-24-00015412)

T-Mobile	Carrier	5-10-2007	Android Project: Software	• 7 Dalvik, at-361	GOOGLE-56-00017330

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
			Functional Requirements Document for Release 1.0 (Version 0.99.1)	○ 7.1 Overview Dalvik is a Java-like runtime that runs standard Java .class/.jar files – after they have been translated for efficient on-device storage. ○ 7.2 Platform The Dalvik runtime will have functionality that is a subset of Java Platform, Standard Edition (J2SE) 1.5. The following libraries will be supported: ▪ java.lang ▪ java.lang.ref ▪ java.lang.reflect ▪ java.io ▪ java.math ▪ java.net ▪ java.text ▪ java.nio.* ▪ java.utillogging ▪ java.util.prefs ▪ java.util.regex ▪ java.util ▪ java.util.jar ▪ java.util.zip ▪ java.awt.image.renderable ▪ java.awt.*[] ▪ java.awt.image ▪ javax.imageio.* ▪ java.security ▪ java.security.acl ▪ java.security.cert ▪ java.security.interfaces ▪ java.security.spec ▪ javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec ▪ javax.net.ssl	(Parent: GOOGLE-56-00017329)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ javax.security.cert ▪ java.sql ▪ javax.sql ○ 7.4 Additional APIs, at -362 ▪ 7.4.1 Bluetooth: JSR 82: Java APIs for Bluetooth will be supported. ▪ 7.4.2 PDA: JSR 75: PDA Optional Packages for the J2ME Platform will be supported. ▪ 7.4.3 OpenGL ES: JSR 239: Java Binding for the OpenGL ES API	
HTC	OEM	5-11-2007 10-16-2007	Android Project: Software Functional Requirements Document for Release 1.0 (Version 0.99)	• 7 Dalvik, at -116 ○ 7.1 Overview Dalvik is a Java-like runtime that runs standard Java .class/.jar files – after they have been translated for efficient on-device storage. ○ 7.2 Platform The Dalvik runtime will have functionality that is a subset of Java Platform, Standard Edition (J2SE) 1.5. The following libraries will be supported: ▪ java.lang ▪ java.lang.ref ▪ java.lang.reflect ▪ java.io ▪ java.math ▪ java.net ▪ java.text ▪ java.nio.* ▪ java.utillogging ▪ java.util.prefs ▪ java.util.regex ▪ java.util ▪ java.util.jar ▪ java.util.zip ▪ java.awt.image.renderable ▪ java.awt.* [] ▪ java.awt.image ▪ javax.imageio.* ▪ java.security ▪ java.security.acl	GOOGLE-03-00067085 (May 2007) (Parent for May 2007: GOOGLE-03-00067083) GOOGLE-22-00124385 (October 2007) (Parent for October 2007: GOOGLE-22-00124382)

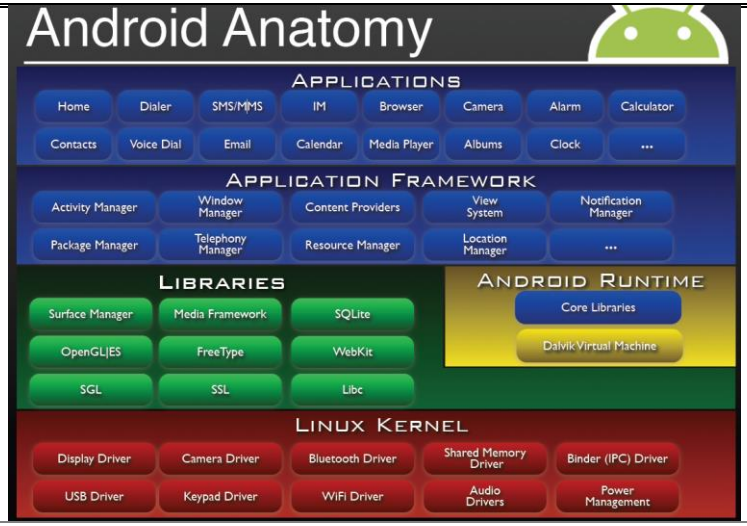
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ java.security.cert ▪ java.security.interfaces ▪ java.security.spec ▪ javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec ▪ javax.net.ssl ▪ javax.security.cert ▪ java.sql ▪ javax.sql o 7.4 Additional APIs, at -117 ▪ 7.4.1 Bluetooth: JSR 82: Java APIs for Bluetooth will be supported. ▪ 7.4.2 PDA: JSR 75: PDA Optional Packages for the J2ME Platform will be supported. ▪ 7.4.3 OpenGL ES: JSR 239: Java Binding for the OpenGL ES API	
Public presentation by Mike Cleron (Engineer on the Android development team)	The public	11-12-2007	Video presentation: Androidology Part 1 of 3 – Architecture Overview	• Android stack block diagram, at 3:10-7:10 o Android Runtime: Core Libraries; Dalvik Virtual Machine	TX 3165; https://www.youtube.com/watch?v=QBGfUs9mQYY (uploaded November 12, 2007)

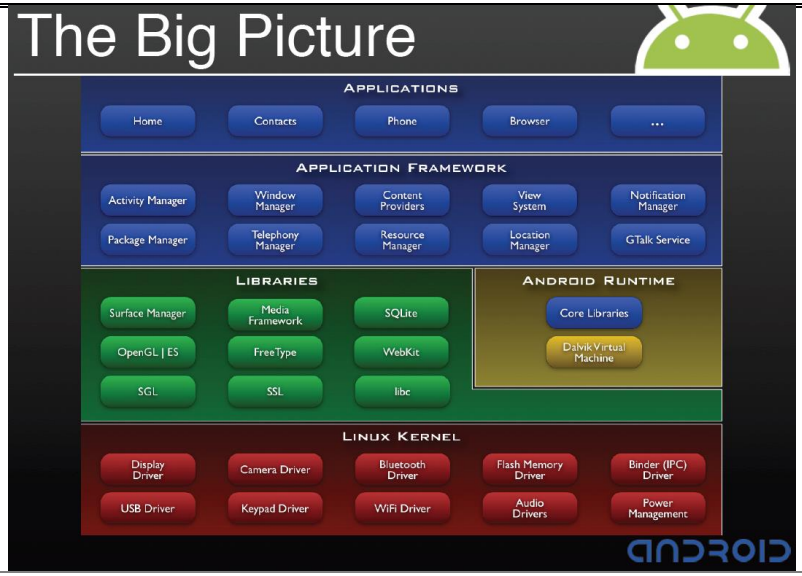
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
					
Docomo	Carrier	[]-[]-2008	Google's Role: What Google would like to accomplish with DCM/Google Partnership	• Goal 2: Open Architecture, at -872 ○ Powerful, simple application framework with Java language APIs ▪ No need for developers to learn a new language or work low-level programming details ▪ Enabling reuse and replacement of components	GOOGLE-22-00059866 (Parent: GOOGLE-22-00059865)
Asus	OEM	4-11-2008	Android Project: Software Functional Requirements Document for Release 1.0 (Version 0.99)	• 7 Dalvik, at -107 ○ 7.1 Overview Dalvik is a Java-like runtime that runs standard Java .class/.jar files – after they have been translated for efficient on-device storage. ○ 7.2 Platform The Dalvik runtime will have functionality that is a subset of Java Platform, Standard Edition (J2SE) 1.5. The following libraries will be supported: ▪ java.lang ▪ java.lang.ref ▪ java.lang.reflect ▪ java.io ▪ java.math ▪ java.net ▪ java.text	GOOGLE-22-00072076 (Parent: GOOGLE-22-00072075)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ java.nio.* ▪ java.utillogging ▪ java.util.prefs ▪ java.util.regex ▪ java.util ▪ java.util.jar ▪ java.util.zip ▪ java.awt.image.renderable ▪ java.awt.* [] ▪ java.awt.image ▪ javax.imageio.* ▪ java.security ▪ java.security.acl ▪ java.security.cert ▪ java.security.interfaces ▪ java.security.spec ▪ javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec ▪ javax.net.ssl ▪ javax.security.cert ▪ java.sql ▪ javax.sql o 7.4 Additional APIs, at -108 ▪ 7.4.1 Bluetooth: JSR 82: Java APIs for Bluetooth will be supported. ▪ 7.4.2 PDA: JSR 75: PDA Optional Packages for the J2ME Platform will be supported. ▪ 7.4.3 OpenGL ES: JSR 239: Java Binding for the OpenGL ES API	
BORQS	OEM	5-8-2008	Android Project: Software Functional Requirements Document for	• 7 Dalvik, at -855 o 7.1 Overview Dalvik is a Java-like runtime that runs standard Java .class/.jar files – after they have been translated for efficient on-device storage.	GOOGLE-22-00051824 (Parent: GOOGLE-22-00051822)

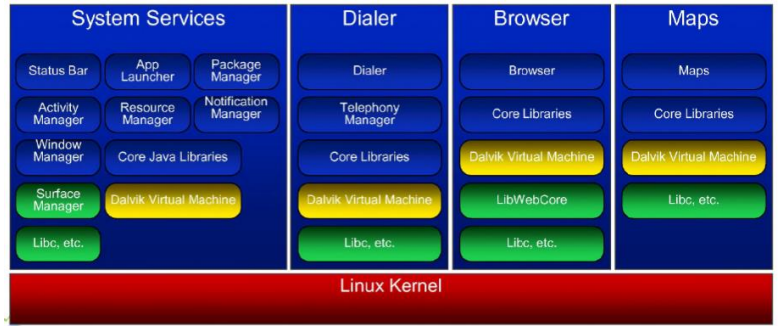
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
			Release 1.0 (Version 0.99)	○ 7.2 Platform The Dalvik runtime will have functionality that is a subset of Java Platform, Standard Edition (J2SE) 1.5. The following libraries will be supported: ▪ java.lang ▪ java.lang.ref ▪ java.lang.reflect ▪ java.io ▪ java.math ▪ java.net ▪ java.text ▪ java.nio.* ▪ java.utillogging ▪ java.util.prefs ▪ java.util.regex ▪ java.util ▪ java.util.jar ▪ java.util.zip ▪ java.awt.image.renderable ▪ java.awt.* [] ▪ java.awt.image ▪ javax.imageio.* ▪ java.security ▪ java.security.acl ▪ java.security.cert ▪ java.security.interfaces ▪ java.security.spec ▪ javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec ▪ javax.net.ssl ▪ javax.security.cert ▪ java.sqlvax.sql ○ 7.4 Additional APIs, at -856	

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ 7.4.1 Bluetooth: JSR 82: Java APIs for Bluetooth will be supported. ▪ 7.4.2 PDA: JSR 75: PDA Optional Packages for the J2ME Platform will be supported. ▪ 7.4.3 OpenGL ES: JSR 239: Java Binding for the OpenGL ES API	
Satyam	IT Services Company	5-22-2008	Android: HCU-ADMS (Java Open Source)	• Technical overview, at -507 o Dalvik virtual machine optimized for mobile devices o Android Runtime: Core libraries; Dalvik Virtual Machine	GOOGLE-17-00679502 (Parent: GOOGLE-17-00679499)
Public presentation by Patrick Brady (Android technology program manager at partner solutions group)	The public	5-28-2008	Google I/O 2008 – Anatomy and Physiology of an Android	Presentation at Google I/O 2008 • Video presentation at 37:15: Android Runtime: Core Libraries; Dalvik Virtual Machine  • Accompanying slide presentation, at 177	X 815; https://www.youtube.com/watch?v=G-36noTCaiA (uploaded June 9, 2008); Slides: https://sites.google.com/site/io/anatomy--physiology-of-an-android

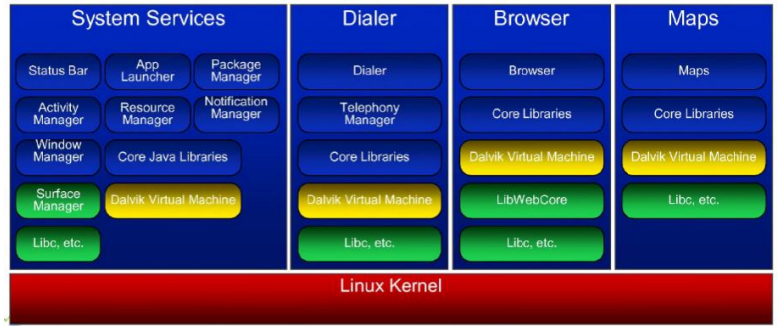
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
					
Public presentation by Dan Bornstein (lead engineer for	The public	5-29-2008	Google I/O 2008 – Dalvik Virtual Machine Internals	Presentation at Google I/O 2008 • Video presentation at 1:30: Android Runtime: Core Libraries; Dalvik Virtual Machine  • Accompanying slide presentation, at 4	https://www.youtube.com/watch?v=ptjedOZEXPM (uploaded on June 3, 2008) Slides: TX 32 (Joint Exhibit List ADMITTED Phase 2); https://sites.google.com/site/io/dalvik-vm-internals

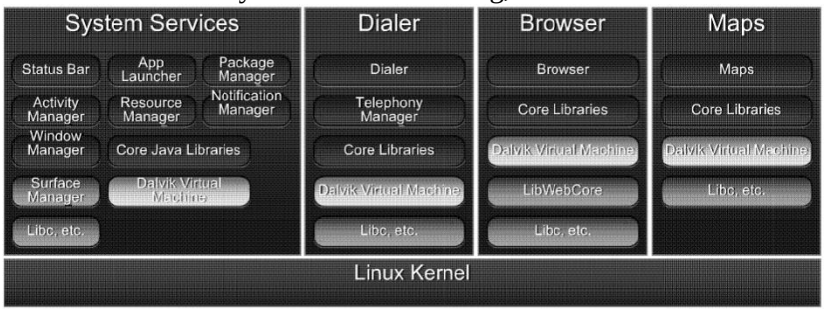
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
					
Dell	OEM	8-12-2008	Android Project: Software Functional Requirements Document for Release 1.0 (Version 0.99.6)	• 7 Dalvik, at -632 ○ 7.1 Overview Dalvik is a custom runtime developed specifically for the Android platform. It can run .class/.jar files after they have been translated for efficient on-device storage. ○ 7.2 Platform The Dalvik runtime will support a subset of the core library APIs present in Java Platform, Standard Edition (J2SE) 1.5. The following libraries will be supported: ▪ java.lang ▪ java.lang.ref ▪ java.lang.reflect ▪ java.io ▪ java.math ▪ java.net ▪ java.text ▪ java.nio.* ▪ java.util.logging ▪ java.util.prefs ▪ java.util.regex ▪ java .util	GOOGLE-22-00066600 (Parent: GOOGLE-22-00066598)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
				▪ java.util.jar ▪ java.util.zip ▪ java.awt.image.renderable ▪ java.awt.* [] ▪ java.awt.image ▪ javax.imageio.* ▪ java.security ▪ java.security.acl ▪ java.security.cert ▪ java.security.interfaces ▪ java.security.spec ▪ javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec javax.net ▪ javax.sound.* ▪ javax.xml ▪ javax.transaction.* ▪ javax.crypto ▪ javax.crypto.interfaces ▪ javax.crypto.spec ▪ javax.net.ssl ▪ javax.security.cert ▪ java.sql ▪ javax.sql ○ 7.4 Additional APIs, at -633 ▪ 7.4.1 Bluetooth: JSR 82: Java APIs for Bluetooth will be supported. ▪ 7.4.2 PDA: JSR 75: PDA Optional Packages for the J2ME Platform will be supported. ▪ 7.4.3 OpenGL ES: JSR 239: Java Binding for the OpenGL ES API	
HTC	OEM	8-27-2008	3-way meeting: Google, HTC, and Vodafone	• Goal 2: Open Architecture, at -838 ○ Powerful, simple application framework with Java language APIs	GOOGLE-22-00039829

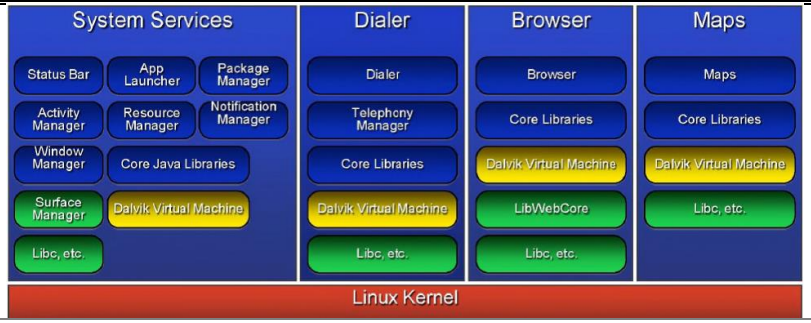
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
			Open Handset Alliance: Pioneer Kick Off Meeting	▪ No need for developers to learn a new language or work with low-level programming details ▪ Enabling reuse and replacement of components • Android Architecture, at -842 o Android stack block diagram ▪ Android Runtime: Core libraries; Dalvik Virtual Machine • Android Runtime: Dalvik VM, at -845 o Android's custom clean-room implementation virtual machine ▪ Java .class/ .jar files converted to .dex at build time • Android Runtime: Core Libraries, at -847 o Core APIs for Java language provide a powerful, yet simple and familiar development platform • Linux Security: Process Partitioning, at -859  • Slide Notes, at -875 o Slides 10, 15, 16, 20: Will be able to use any J2ME application on the platform.	(Parent: GOOGLE-22-00039825)
Vodafone	Carrier	8-27-2008	3-way meeting: Google, HTC, and Vodafone Open Handset Alliance: Pioneer Kick Off Meeting	• Goal 2: Open Architecture, at -838 o Powerful, simple application framework with Java language APIs ▪ No need for developers to learn a new language or work with low-level programming details ▪ Enabling reuse and replacement of components • Android Architecture, at -842 o Android stack block diagram ▪ Android Runtime: Core libraries; Dalvik Virtual Machine	GOOGLE-22-00039829 (Parent: GOOGLE-22-00039825)

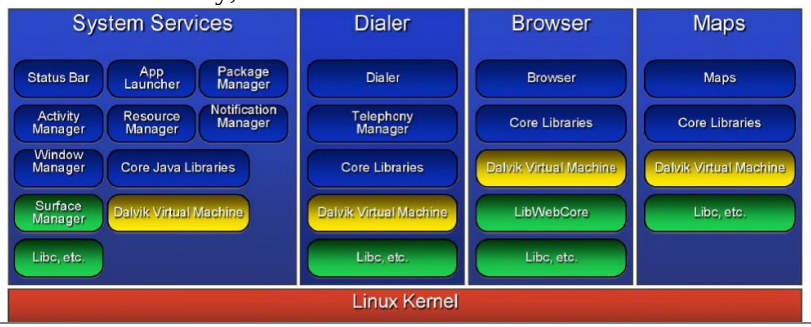
Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.

				• Android Runtime: Dalvik VM, at -845
				  ○ Android's custom clean-room implementation virtual machine
				  ▪ Java .class/ .jar files converted to .dex at build time
				• Android Runtime: Core Libraries, at -847
				  ○ Core APIs for Java language provide a powerful, yet simple and familiar development platform
				• Linux Security: Process Partitioning, at -859
				 
				• Slide Notes, at -875
				Slides 10, 15, 16, 20: Will be able to use any J2ME application on the platform.	

AT&T	Carrier	9-11-2008	AT&T / Google Android Collaboration	• Android Security: Process Partitioning, at –050 	GOOGLE-82-00048045 (Parent: GOOGLE-82-00048043) (Document showing date of meeting: GOOGLE-25-00042115)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
AT&T	Carrier	9-22-2009 8:34 AM	Draft AT&T + Google: Android Market Review	• Android API Overview, at -313 ○ In order to have an Open Platform, developers should have all the tools and features of a Mobile phone available to their applications ○ Application Fundamentals ▪ Core Java Libraries • Text rendering • Network access • File system access	GOOGLE-22-00105306 (Parent: GOOGLE-22-00105302)
AT&T	Carrier	9-22-2009 8:48 AM	AT&T + Google: Android Market Review	• Android API Overview, at -271 ○ In order to have an Open Platform, developers should have all the tools and features of a Mobile phone available to their applications ○ Application Fundamentals ▪ Core Libraries • Text rendering • Network access • File system access	GOOGLE-25-00044264 (Parent: GOOGLE-25-00044260)
Toshiba	OEM	[]-[]-2010	Android Overview: Android, ecosystem and the Open Handset Alliance	• Goal 2: Open Architecture, at -931 ○ Powerful, simple application framework with Java language APIs ▪ No need for developers to learn a new language or work low-level programming details ▪ Enabling reuse and replacement of components • Android Architecture, at -935 ○ Android stack block diagram ▪ Android Runtime: Core libraries; Dalvik Virtual Machine • Android Runtime: Dalvik VM, at -938 ○ Android's custom clean-room implementation virtual machine ▪ Java .class/ .jar files converted to .dex at build time • Android Runtime: Core Libraries, at -940 ○ Core APIs for Java language provide a powerful, yet simple and familiar development platform • Linux Security, at 952	GOOGLE-22-00169914 (Parent: GOOGLE-22-00169913)

Company	Type of company	Presentation date	Type of presentation	Reference to Java technology	Trial Exh./Bates No.
					

Lenovo	OEM	5-17-2010	Android Overview: Android, ecosystem and the Open Handset Alliance	• Goal 2: Open Architecture, at -931
				  ○ Powerful, simple application framework with Java language APIs
				  ▪ No need for developers to learn a new language or work low-level programming details
				  ▪ Enabling reuse and replacement of components
				• Android Architecture, at -935
				  ○ Android stack block diagram
				  ▪ Android Runtime: Core libraries; Dalvik Virtual Machine
				• Android Runtime: Dalvik VM, at -938
				  ○ Android's custom clean-room implementation virtual machine
				  ▪ Java .class/ .jar files converted to .dex at build time
				• Android Runtime: Core Libraries, at -940
				  ○ Core APIs for Java language provide a powerful, yet simple and familiar development platform
				• Linux Security, at 952
				 
					GOOGLE-22-00169914
					
					(Parent: GOOGLE-22-00169913)